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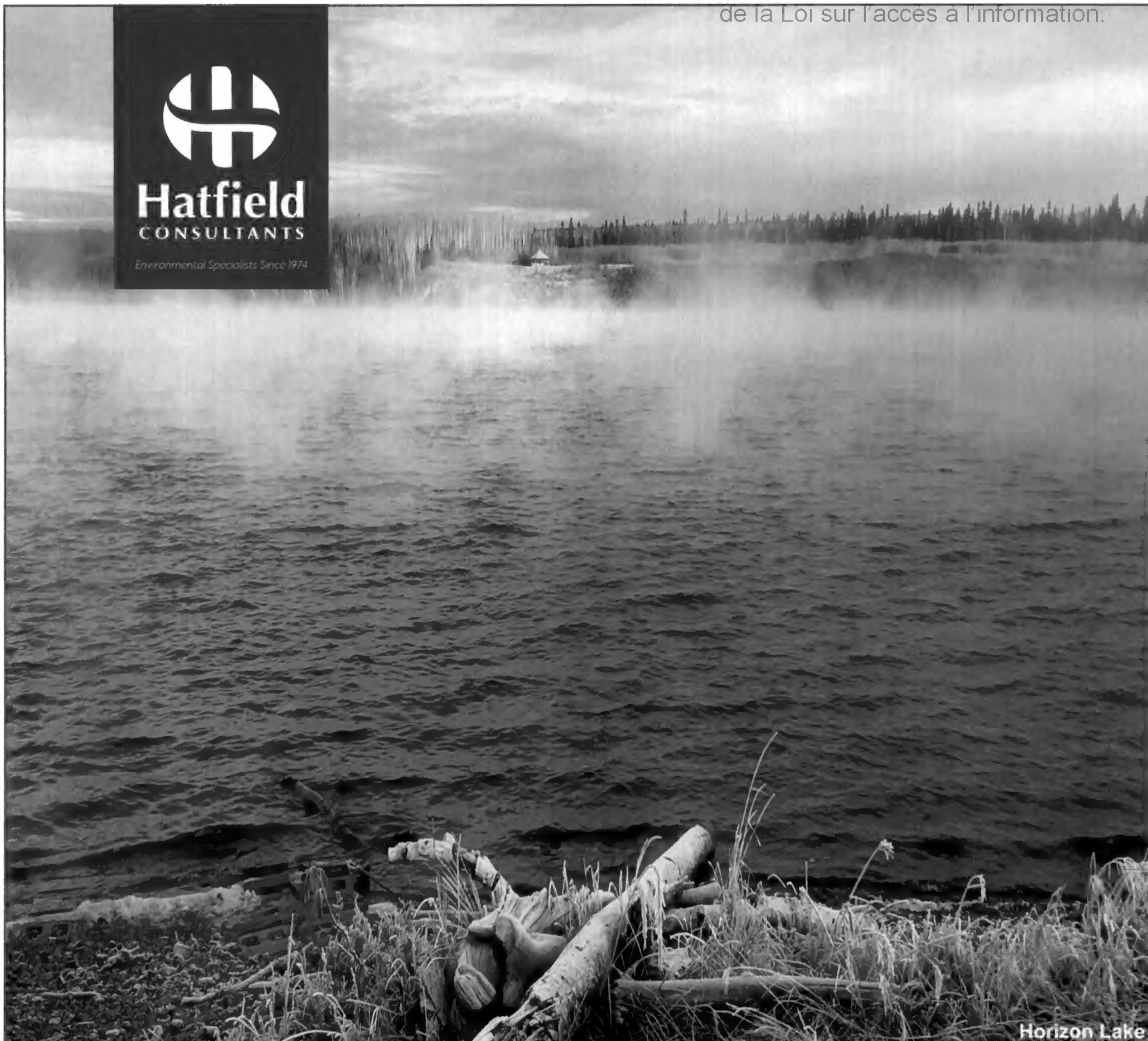

Horizon Lake

Horizon Lake Monitoring Program 2018 Technical Report

June 2019

Prepared for:
Canadian Natural Resources Limited
Fort McMurray, Alberta

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HORIZON LAKE MONITORING PROGRAM

2018 TECHNICAL REPORT

Prepared for:

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LIST OF ACRONYMS

AENV	Alberta Environment
AEP	Alberta Environment and Parks
AESRD	Alberta Environment and Sustainable Resource Development
ANCOVA	Analysis of Covariance
ARGR	Arctic grayling
ATSDR	Agency for Toxic Substances and Disease Registry
BRST	Brook stickleback
BURB	Burbot
CABIN	Canadian Aquatic Biomonitoring Network
CCME	Canadian Council of Ministers for the Environment
CoC	Chain-of-custody
CPUE	Catch per unit effort
D	Simpson's Diversity Index
DD4	Diversion Ditch 4
DEC	Decimal
DFO	Fisheries and Oceans Canada
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
E	Evenness
eDNA	Environmental DNA
e.g.	For example
EPT	Ephemeroptera, Plecoptera, Trichoptera
EqP	Equilibrium Partitioning
ETO	Ephemeroptera, Trichoptera, Odonata
FNDC	Finescale dace
FTMN	Fathead minnow
FWI	Field Work Instructions
G_a	Instantaneous Growth Rate
GoA	Government of Alberta
HADD	Harmful Alteration, Disruption or Destruction of Fish Habitat
HI	Hazard Index
HU	Hazard Quotient
ISQG	Interim Sediment Quality Guidelines
JOSMP	Joint Oil Sands Monitoring Plan
K	Condition Factor
K_{oc}	Organic-carbon-water Partition Coefficient
LKCH	Lake chub
LNSC	Longnose sucker
LPL	Lowest Practical Taxonomic Level
n	Sample Size
N/A	Not Available
NAPL	Non-aqueous Phase Liquid

PEL	Probable Effects Level
PAH	Polycyclic Aromatic Hydrocarbon
PHC	Petroleum Hydrocarbon
PW	Porewater
PIT	Passive Integrated Transponder
QA/QC	Quality Assurance and Quality Control
RAMP	Regional Aquatics Monitoring Program
RPD	Relative Percent Difference
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
Sec	Seconds
SLSC	Slimy sculpin
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TRPR	Trout perch
TSI	Trophic State Index
TSS	Total Suspended Solids
TU	Toxic Unit
USEPA	United States Environmental Protection Agency
WHSC	White sucker

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

As part of the regulatory approval of the Canadian Natural Horizon Mine Project (the Project), Fisheries and Oceans Canada (DFO) issued an Authorization for the harmful alteration, disruption or destruction of fish habitat (HADD) under Section 35(2) of the *Fisheries Act* (Authorization # AB01-477-3). The Authorization stipulates that monitoring must be undertaken until such time that the prescribed compensation ratio has been achieved, to the satisfaction of DFO. The first component of the Canadian Natural compensation plan was the construction of the 76.7-hectare Horizon Lake, located in the Tar River watershed.

The Horizon Lake Monitoring Program (the Program) has used a phased approach to assess ecological progression in the lake since construction was completed in 2008. Technical reports have been drafted and submitted to DFO each year, to fulfill annual reporting requirements of the Project Authorization. The primary objective of the 2018 Program was to estimate fish population size and annual fish productivity for Horizon Lake. Chemical, physical, and other biological components of the lake were also monitored to assess ecological progression and function. Additional monitoring was conducted by Canadian Natural under the amended DFO Authorization # ED-03-1183 to assess the condition and activity around the compensation habitat in the upper Tar River, and by Stantec (2019) to assess whether eDNA could be used to detect Arctic grayling and burbot in the Tar River and Horizon Lake.

Most analytes were within the range of CCME (2014) and Alberta (GoA 2018) water quality guidelines for the protection of aquatic life in fall 2018 and winter 2019, except for total phenols and total iron in fall and total mercury in winter, which exceeded both sets of guidelines; all analytes were within the range of historical observations in 2018. Elevated levels of iron and phenols are present in surface waters throughout the region, including the Tar River, with concentrations of iron exceeding guidelines in every sample (n=128) collected from the upper and lower Tar River between 1998 and 2017 (www.ramp-alberta.org; 2017 data provided by AEP), while 59% of samples collected exceeded phenol guidelines.

Total mercury has exceeded the chronic water quality guideline for the protection of aquatic life in Alberta (5 ng/L; Government of Alberta 2018) in 13% of samples (n = 53) collected in Horizon Lake since 2008, while no samples have exceeded the acute Alberta guideline (13 ng/L; Government of Alberta 2018) or the federal CCME guideline (26 ng/L; CCME 2014) for the protection of aquatic life. Similarly, 12% of samples (n = 121) collected from the upper and lower Tar River between 2003 and 2017 have exceeded the chronic water quality guideline in Alberta, with 2% exceeding the acute guideline and 1% exceeding the CCME guideline.

The trophic status index (TSI; Wetzel 2001) for the lake suggested a eutrophic system in fall and mesotrophic system in winter of 2018. Nutrient status based on the N:P ratio indicates that the lake was co-limited in fall 2018 and strongly phosphorous limited in winter 2019. This result is similar to historical conditions, where 55% of measurements have indicated the lake was phosphorous limited and 42% indicated it was co-limited. Overall, the lake is stabilizing to an upper mesotrophic to slightly eutrophic nutrient regime, which will continue to provide nutrients for the growth of primary producers and sustain the aquatic foodweb.

Winter DO profiles measured each year from 2008 to 2018 have confirmed that sufficient levels of oxygen continue to be available to support overwintering of all fish species present in Horizon Lake.

All metal concentrations in sediments were below applicable interim sediment quality guidelines (ISQG) and probable effects levels (PEL) at all three lake sites in 2018, except for arsenic, which has exceeded in

all previous years. Exceedances of the arsenic ISQG were also observed in pre-disturbance monitoring (www.ramp-alberta.org) of the lower Tar River (33%, n=3) and the Calumet River (21%, n=11). Hydrocarbon concentrations were below detection limits, except for Fraction 3 at BEN-2 and BEN-3; however, concentrations were below the ISQG at both sites and below the range of historical observations at BEN-3. Concentrations of all PAHs were below ISQ and PEL guidelines in 2018, and well below the Hazard Index threshold of 1.0, suggesting there is low potential for PAH and total hydrocarbon toxic effects on the aquatic life in Horizon Lake.

The phytoplankton community in Horizon Lake was comprised of a high density of cryptophytes, followed by diatoms and cyanobacteria, which have also been abundant in previous years. Cyanobacteria and dinoflagellates comprised the majority of biomass in 2018. Cyanobacteria has been the most dominant taxa by biomass since monitoring began, with the exception of 2017. Average phytoplankton density and biomass have shown seasonal fluctuations from year-to-year; 2018 observations were within the historical range in spring and fall and below the historical minimum in summer. Horizon Lake has generally supported a moderate to highly diverse phytoplankton community; however, low evenness indicates the community is dominated by high abundances of a few taxa.

Mean zooplankton density and biomass were within the range of previous years in 2018, with rotifers and ciliates contributing the highest density and biomass in all seasons; rotifers have generally made up the highest proportion of the density and biomass in all seasons in previous years. The presence of ciliates has not been consistent from year-to-year, with observations in all three seasons of annual monitoring occurring only in 2012, 2015, 2017, and 2018. Overall, Horizon Lake supports a low to moderately diverse and moderately variable zooplankton community. Similar to the phytoplankton community, low evenness indicates that the abundance of individual zooplankton taxa is not equal in Horizon Lake and the community is dominated by a few taxa.

Natural variability has been observed in phytoplankton and zooplankton taxonomic richness, biomass, abundance, and community composition in Horizon Lake. The seasonal and temporal variations in these community metrics are likely caused by short-term changes in nutrient composition and other physical factors within the lake (e.g., fluctuations in water depth, wind mixing, and temperature).

Chironomid midges (Diptera) were the most abundant taxon by density in all three depth strata in 2018. Phantom midges (Chaoboridae) and oligochaete worms were also dominant contributors to mid-lake density, while the second most common taxon at the littoral and near-shore areas was oligochaete worms. Similar to previous years, average benthic invertebrate density and richness in 2018 were highest in the near-shore area, followed by the littoral area, and the mid-lake area. This was expected given shallower lake regions generally have greater amounts of oxygen and primary production, higher habitat heterogeneity, and greater food resources available. It is also known that habitats that receive limited light exposure (i.e., deeper waters) are known to deter colonization by many benthic invertebrate species.

Benthic invertebrate communities have generally been dominated by collector-gatherers at all areas in all years. Near-shore benthic invertebrate communities have generally contained a higher number of functional feeding groups, including macrophyte herbivores, omnivores, scrapers, and shredders. This range is indicative of a greater number of food sources available closer to shore, and adequate nutrients and light for periphyton and phytoplankton to flourish.

Overall, the benthic invertebrate community in Horizon Lake suggests an improvement in habitat quality since monitoring began, which may be a result of more diversity in primary production and food sources for invertebrates, and more available niches. Fluctuations are likely reflecting seasonal variation in temperature and water quality, as increasing baseline diversity and evenness are reflective of increasing robustness within the invertebrate population of Horizon Lake.

A total of 2,084 fish were captured during the spring migration program, consisting primarily of forage fish caught in minnow traps. Fathead minnow were by far the most abundant species, comprising 92% of the total forage fish captures. The remaining 8% of the forage fish community included lake chub, brook stickleback, slimy sculpin, and a single trout-perch. A total of 93 large-bodied fish were also captured in the upper Tar River, consisting of five Arctic grayling and near equal proportions of longnose (n = 46) and white sucker (n=47); most of these large-bodied fish were captured in fyke nets deployed between May 22 and 24.

The PIT antennae system has detected 1,274 of the 4,078 tags in the tag database (31%) since the installation of the first antenna array in 2013. The number of observations per year has varied, particularly since the installation of the upstream antenna in early 2016. The timing of upstream residence varies among species and among years, based on the three years of concurrent lower and upper PIT tag antennae data (2016 to 2018). Generally, the first upstream movements for Arctic grayling, longnose sucker, and white sucker were all observed in early May. All three species also show upstream movement throughout the summer, although most of these movements were observed prior to the end of June. Longnose sucker were observed to have the longest and most frequent upstream durations in summer 2018, relative to other species and to previous years. In addition, a bi-modal distribution of upstream trips may be evident for longnose sucker. Arctic grayling have also exhibited extended upstream residence times, although the number of records is limited.

Snorkel surveys were used to visually assess species assemblages, fish distribution, fish abundance, and habitat use in the upper Tar River. There were a limited number of observations in 2018, which may have been due to the timing of the survey that occurred from May 29 to June 2, after the spring migration period for Arctic grayling and white sucker and in between the bi-modal distribution of upstream trips for longnose sucker.

Over the past three years, there has been a substantial movement of fish within the upper Tar River during spring. Based on life-histories of these fish and observations from the fish fence program in previous years, these movements appear to primarily support spring spawning activities, suggesting the Tar River provides suitable spawning habitat for resident fish and contributes to the recruitment of fish to Horizon Lake.

Total and methyl mercury concentrations in fathead minnow and lake chub composite samples from Horizon Lake generally decreased from 2010 to 2017, before increasing slightly in 2018. Total and methyl mercury in juvenile white sucker composite samples collected from Horizon Lake in 2018 were the lowest observed since monitoring began in 2011. This is also the first year since monitoring began that concentrations of total and methyl mercury in white sucker composites collected from Horizon Lake were lower than concentrations in fish collected from the Calumet reference watershed; insufficient numbers of lake chub and fathead minnow were captured to allow Calumet reference watershed comparisons to be made in 2018. As in previous years, all the composite samples were below the Health Canada (2007a) guidelines for subsistence fishers (0.2 mg/kg) and general consumers (0.5 mg/kg) in 2018.

Concentrations of total metals in adult white sucker fish tissue samples collected in 2018 were below human health consumption guidelines, with the exception of arsenic, chromium, and mercury, which exceeded the National USEPA and/or Region III USEPA guidelines; concentrations of arsenic and chromium exceeded in all samples collected from Horizon Lake and the Calumet reference watershed, while mercury exceeded in all adult white sucker samples and the lake chub composites from Horizon Lake. This was the first year that total mercury concentrations in all adult white sucker muscle tissue samples were below the 0.2 mg/kg Health Canada (2007a) guideline for subsistence fisheries, and median concentrations of both total and methyl mercury in 2018 were lower than all previous years.

While investigating how to incorporate the length distributions from the hydroacoustic survey into the species composition numbers in 2018, an error was discovered in the species compositions that were used for the 2015 and 2016 production estimates, which skewed the results towards large-bodied species (Appendix A1). After reanalyzing with the correct species compositions, the overall production estimates decreased from 3,600 to 1,461 kg/year in 2015 and from 2,800 to 2,379 kg/year in 2016.

The peak production observed to date in Horizon Lake occurred during the first two years of hydroacoustic monitoring, measuring 2,524 kg/year in 2013 and 2,700 kg/year in 2014, which were close to the offsetting target of 2,543 kg/year. Three of the four production estimates since 2015 have been substantially lower than these first two years, although 2016 was high and at 2,379 kg/year was also near the annual production target. Fish production was 1,100 kg in 2018, which was higher than 2017 (790 kg/year) but lower than all other years of hydroacoustic monitoring. The last six years of production monitoring appears to show a decreasing trend; however, future monitoring will be important to determine whether the large-bodied fish species in Horizon Lake are stabilizing or declining, or whether there is simply high annual variability in these populations.

The results of the first ten years of monitoring have demonstrated that Horizon Lake provides a variety of functional habitats and food sources that are suitable to support year-round fish populations, and that the physical and chemical environment is well suited to the establishment and proliferation of aquatic life.

A habitat enhancement structure consisting of a rock V-weir and excavated scour pool was constructed across the width of the Tar River in 2012, as part of the amended DFO Authorization # ED-03-1183. The primary objective of this enhancement was to create summer feeding and overwintering habitats for Arctic grayling with the goal of promoting the establishment of grayling in Horizon Lake. Monitoring of this weir indicates that there is seasonal use by Arctic grayling and other fish species within and around the rock weir. The structural integrity of the rock weir continues to be stable, with no changes over numerous spring freshets. Beaver activity will continue to be monitored and additional mitigation will be undertaken in 2019 to minimize the availability of trees for beavers to use. As outlined in letter 03-HCAA-CA-01183 on January 27, 2012 from Fisheries and Oceans Canada, 2018 is the last year of fish and water quality monitoring for the weir.

Arctic grayling eDNA was detected at one site in Horizon Lake while burbot eDNA was not detected at any of the sample sites. Potential explanations for no detection of Arctic grayling and burbot eDNA include: low abundance or absence of the target species in the vicinity of the sample sites at the time of field sampling; concentrations of DNA in the lake were below the limit of detection for the assay, which may be due to a low rate of DNA "shedding" to the environment or a high rate of DNA degradation; the latter is considered unlikely due to low water temperatures.

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AMENDMENT RECORD

This report has been issued and amended as follows:

Issue	Description	Date	Approved by	
1	First version of Horizon Lake Monitoring Program 2018 Technical Report	20190430	Daniel Moats Program Director	Daniel Moats Project Manager
2	Second version of Horizon Lake Monitoring Program 2018 Technical Report	20190626	Daniel Moats Program Director	Daniel Moats Project Manager

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1.0 INTRODUCTION

The Canadian Natural Resources Limited (Canadian Natural) Horizon Oil Sands Project (the Project) is a surface mine and bitumen extraction facility located approximately 75 kilometers (km) northwest of Fort McMurray, on the west side of the Athabasca River. The Project received authorization from Fisheries and Oceans Canada (DFO) in the spring of 2004 for Harmful Alteration, Disruption, and Destruction (HADD) of fish habitat under Section 35(2) of the *Fisheries Act* (Authorization # AB01-477-3). Conditions of the Authorization pursuant to Section 35(2) provide specific direction regarding measures to be taken for assessment of lost and gained (offset) fish habitat productive capacity. Article 9.0 of the Authorization states:

> "*The Plan shall define the procedures and undertaking to achieve permanent fish habitat productive capacity gains that offset fish habitat productive capacity losses to meet a compensation ratio of 2:1 (hereafter referred to as Comp Ratio) based on fish biomass productivity*".

Article 17.1 of the Authorization further specifies that:

> "*Plan Monitoring shall include: monitoring of fish habitat use, habitat productivity and self-sustaining fish populations (including successful spawning and recruitment); assessment of fish utilization of compensation structures in all seasons; monitoring of water quality, sediment quality, thermal regime, aquatic vegetation and benthic invertebrates; monitoring the discharge from the Comp Lake outlet to verify the modeling upon which the hydrologic feasibility assessment was based; and monitoring of fishing pressure in the Comp Lake and the effects of fish harvest on the sustainability of the populations*".

A No Net Loss Habitat Compensation and Monitoring Plan (Golder 2004) was developed to provide a path forward to permanently offset losses of fish habitat resulting from the development of the Project. The compensation will include a 76.7-hectare (ha) compensation lake (Horizon Lake) and a 46.7-ha permanent closure channel. The lake and closure channel have been designed to provide suitable habitat to support self-sustaining resident fish populations at a 2:1 offset of the predicted production losses resulting from the Project. Horizon Lake was completed in 2008 in the Tar River watershed, and the closure channel will be constructed in 2044 to replace the main operational diversion channels; the lake will then discharge into the closure channel, which will border the northern edge of the Horizon Mine. The closure channel will provide additional habitat offsets by creating permanent riverine habitat between Horizon Lake and the Athabasca River.

Canadian Natural created a back channel on the Athabasca River in 2007 to offset the habitat losses associated with construction of the river water intake for the Horizon Mine, as part of DFO Authorization # ED-03-1183. By 2009, it was determined by Canadian Natural and DFO that the constructed habitat on the Athabasca River was no longer functioning as intended. An amended Authorization was provided in January 2012, which approved the construction of new compensation habitat. A habitat enhancement structure consisting of a rock V-weir and excavated scour pool was constructed across the width of the Tar River in 2012, approximately 350 m upstream of the Horizon Lake inlet (Golder 2011b; Appendix A2 Figure 1).

1.1 BACKGROUND

The two primary objectives of the Horizon Lake Monitoring Program (the Program) are to: (1) develop reliable fish production estimates for each species present in the lake, to determine whether compensation conditions detailed in the Project Authorization are being met; and (2) confirm the lake is ecologically and physically functioning prior to commencement of Phase 2 of the Project, which consists of alterations to the Calumet River watershed. These objectives have been fulfilled by utilizing scientifically defensible sampling methods and analyses to:

- monitor habitat use, habitat productivity, and self-sustaining fish populations;
- quantify annual fish biomass production per unit area for target species in the lake;
- track trophic status to ensure Horizon Lake continues to progress towards an ecologically self-sustaining waterbody at an acceptable rate; and
- provide information to make adaptive management decisions for future monitoring programs.

This document has been prepared on behalf of Canadian Natural to fulfill reporting requirements from their Project Authorization; 2018 represents the tenth year of monitoring at Horizon Lake. Additionally, information on the monitoring of the compensation habitat located upstream of Horizon Lake, as required under Authorization ED-03-1183, was jointly prepared by Hatfield Consultants and Canadian Natural and is included in this report. The data for the upper Tar River compensation habitat represents year seven, which has been deemed the final year of this monitoring program. The objective of the upper Tar River enhancement was to create summer feeding and overwintering habitats, with the intention of promoting the establishment of Arctic grayling (ARGR; *Thymallus arcticus*) in the lake.

1.2 STUDY AREA OVERVIEW

1.2.1 Tar River Watershed

The Tar River has a total drainage area of 333 km^2 and a headwater elevation of approximately 810 m. The river originates in the Birch Mountains, joining the Athabasca River just north of the community of Fort McKay (Figure 1.1). Flows for the Tar River are recorded at the Joint Oil Sands Monitoring Plan (JOSMP) station S34, located upstream from Horizon Lake, and stations S15 and S15A, both of which are located near the Athabasca River confluence. Additional JOSMP monitoring undertaken on the Tar River has included assessments of snow pack, climate, water and sediment quality, benthic invertebrate communities, and fish assemblages (www.ramp-alberta.org).

Construction of a dam across the mainstem of the Tar River was initiated in 2008, which backflooded the upstream river valley and created Horizon Lake. A habitat enhancement structure consisting of a rock V-weir and excavated scour pool was constructed across the width of the Tar River in 2012, approximately 350 m upstream of the Horizon Lake inlet (Golder 2011b). The primary objective of this enhancement was to create summer feeding and overwintering habitats for ARGR with the goal of promoting the establishment of ARGR in Horizon Lake.

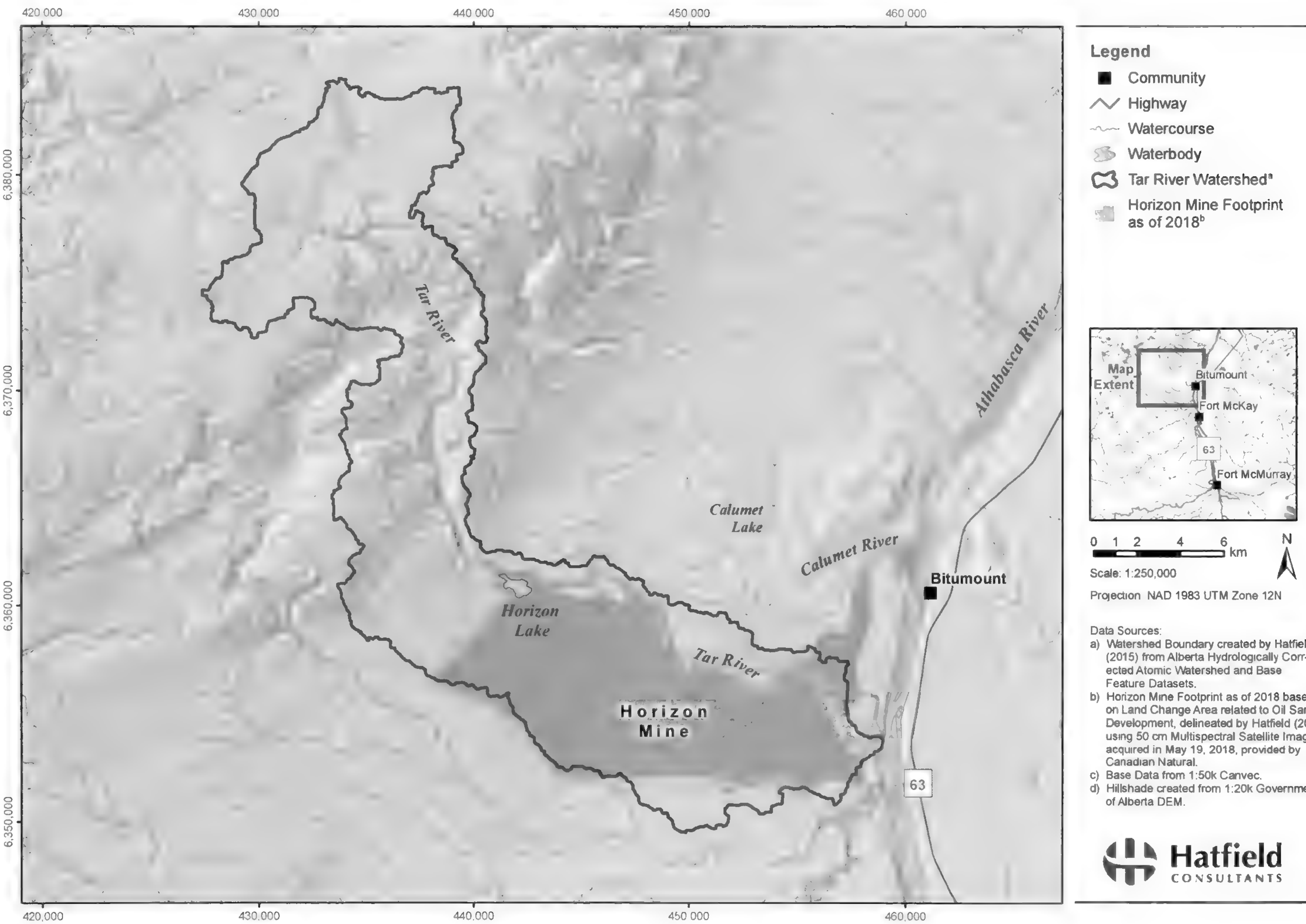
As of 2018, approximately 35% (118 km^2) of the Tar River watershed had undergone land change as a result of the Project (Hatfield 2019), which included disturbances from Plant Phase I (initiated in 2008) and Plant Phase 2A (coker expansion and debottlenecking completed in 2014).

1.2.2 Horizon Lake

Horizon Lake is located within the Tar River watershed, on the western perimeter of the Project development area (Figure 1.1). Creation of Horizon Lake began by damming the Tar River mainstem, with construction completed in the winter of 2007/08 and filling during the following spring freshet. The Tar River now flows into Horizon Lake, which drains to the External Tailings Area via a fish exclusion culvert in the winter; during the open-water season (May-October), Horizon Lake drains through a diversion ditch (DD4) and back into the Tar River. At closure, a diversion channel will be constructed to connect Horizon Lake to the Athabasca River.

Horizon Lake has a total surface area of 76.7 ha, with an average depth of 7.2 m and a maximum depth of 23 m. A number of habitat enhancements were engineered to increase fish productivity throughout the lake, including the addition of suitable substrates for spawning, and a littoral zone comprised of a large shallow bay, rocky shoals, and reefs. The lake is inhabited by ten different fish species, including ARGR, brook stickleback (BRST; *Culaea inconstans*), burbot (BURB; *Lota lota*), finescale dace (FNDC; *Phoxinus neogaeus*), fathead minnow (FTMN; *Pimephales promelas*), lake chub (LKCH; *Couesius plumbeus*), longnose sucker (LNSC; *Catostomus catostomus*), slimy sculpin (SLSC; *Cottus cognatus*), trout-perch (TRPR; *Percopsis omiscomaycus*), and white sucker (WHSC; *Catostomus* commersonii).

Figure 1.1 Study area of the Horizon Lake Monitoring Program.



Tar River Fish Monitoring Program

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1.3 STUDY DESIGN MODIFICATIONS (2008 TO 2018)

The Program has used a phased approach to assess ecological progression since lake construction was completed in 2008. Permanent monitoring sites have been established within pelagic, littoral, and near-shore zones of the lake. Monitoring sites have also been positioned on the Tar River, Calumet River, and Calumet Lake, to provide contextual and comparative data for assessing the productivity and ecological health of Horizon Lake. Several sampling sites were established in 2008 (Year 0) of the monitoring program, which focused on quantifying physical and chemical characteristics of the basin and sampling of lower trophic levels of aquatic organisms, as well as identifying fish species that naturally colonized the lake. In 2009 and 2010 (Years 1 and 2), macrophyte surveys and fish tissue mercury testing were added to the monitoring program, while the frequency of water quality and plankton monitoring was decreased. The fish tissue program was expanded in 2011 (Year 3) to include additional fishing methods and increase sampling effort, to better document species composition and increase tag deployments in the lake. Fish were also collected from the Calumet River watershed to characterize background methyl mercury concentrations in a local, undisturbed watershed. Fish population monitoring was increased in 2012 (Year 4), with the addition of a spring fish passage program in the Tar River, fish tissue organics testing in Horizon Lake and the Calumet River watershed, and a summer fishing program to generate preliminary fish population and production estimates for the lake.

Monitoring shifted from lake establishment to lake development in 2013 (Year 5), a focus that has continued through 2018 (Year 10). The objectives of the lake development assessment are focused on quantifying fish production, to determine if Horizon Lake is achieving targets that satisfy conditions of the *Fisheries Act* Authorization. The frequency of sediment quality monitoring was reduced to every two years after the 2012 program and sampling frequency for water quality and plankton were also reduced from monthly to quarterly. Analytical water quality sampling was further reduced in 2017 to twice annually, in winter and fall. Fishing efforts from 2013 to 2015 focused on determining fish abundance and production estimates using a fall mark-recapture program and a hydroacoustic survey, while the spring sampling program in the Tar River assessed the long-term viability of Horizon Lake fish populations. Since 2013, fishing efforts have focused on quantifying fish abundance and production estimates using a hydroacoustic survey in conjunction with a fish capture program, while the mark-recapture study was removed from the study design in 2016 due to historically low returns of marked fish. A PIT tag antennae array was installed approximately 250 m upstream of Horizon Lake on August 22, 2013 and a second array was installed approximately 380 m upstream of the lake on August 14, 2015. The two arrays are used to document year-round presence and movement of tagged fish within the upper Tar River. The upper Tar River spring monitoring program was redesigned in 2018 to increase the quality of the data collected during the spring migration, eliminate the physical barrier that the fence posed to fish passage, decrease predation, and reduce handling of fish. Adjustments included the removal of the fish fence and the addition of an underwater camera, snorkel surveys, and an ARIS sonar.

A summary of sampling tasks conducted during the first ten years of this monitoring program is provided in Table 1.1. Annual results have been used to inform subsequent monitoring years, which has resulted in adjustments to the timing and frequency of various sampling events. The 5-Year Summary Report (Golder 2013a) synthesized pre-disturbance monitoring data to develop habitat offsetting requirements for the Project. Production estimates for habitat losses due to the Project are provided in Table 1.2. The average total production estimate from habitats lost to the Project is 1,271,416 g/year (95% CI 288-4,405 kg) (Golder 2013a). To achieve the 2:1 compensation ratio target, 2,542,832 g/year of production will need to be provided through the construction of compensation habitats.

Table 1.1 Summary of sampling tasks completed for the Horizon Lake Monitoring Program, 2008 to 2018.

Task Description	2008 (Year 0)	2009 (Year 1)	2010 (Year 2)	2011 (Year 3)	2012 (Year 4)	2013 (Year 5)	2014 (Year 6)	2015 (Year 7)	2016 (Year 8)	2017 (Year 9)	2018 (Year 10)
Water Quality – Analytical	9[1]	B[2]	M[3]	M[4]	M[4]	Q	Q	Q	Q	F,W	F.W
Water Quality – In Situ	B	B,C[5]	M, C[5]	M	M[4]	Q,C[5]	C[5]	C[5]	C[5]	Q	Q
Water Quality – Depth Profiles	B	B	M	M[4],C[5]	M[4]	Q	Q	Q	Q	Q	Q
Sediment Quality – Analytical	F	F	F	F	F	-	F	-	F	-	F
Macrophyte Community Assessment	-	Su	Su,F	Su	Su	Su	-	Su	-	Su	-
Plankton Community Assessments	9[1]	B	5[6]	5[6]	M	Sp,Su,F	Sp,Su,F	Sp,Su,F	Sp,Su,F	Sp,Su,F	Sp,Su,F
Benthic Invertebrate Community Assessments	F	F	F	F	F	F	F	F	F	F	F
Fish Species and Relative Abundance	Su	Sp,Su,F	Sp,Su,F	Sp,Su,F	Sp,F	Sp,F	Sp,F	Sp,F	Sp,F	Sp,F	Sp,F
Fish Tissue Mercury Testing	-	F	F	F	F	F	F	F	F	F	F
Fish Tissue Metals and Organics Testing	-	-	-	-	F	F	F	F	F	F	F
Upper Tar River Fish Monitoring Program	-	-	-	-	Sp[7]	Sp,F[7]	Sp[8]	Sp	Sp	Sp[9]	Sp
Upper Tar River PIT Antennae Analysis	-	-	-	-	-	C	C	C	C	C	C
Horizon Lake Mark-Recapture Program	-	-	-	-	Su,F	-	F	F	-	-	-
eDNA Analysis	-	-	-	-	-	-	-	-	-	-	F
Hydroacoustic Survey	-	-	-	-	-	F	F	F	F	F	F
Bathymetric Survey	Su	-	-	F	-	F	-	F	F	F	F

Sp = Spring; Su = Summer; F = Fall; W = Winter; Q = Quarterly; C = Continuous; '#' = times per year; B = biweekly during open-water season; M = monthly during open-water season.

[1] Sampled bi-weekly from July 1 to October 31.

[2] Additional samples collected in January and April.

[3] Additional sample collected in winter.

[4] Additional samples collected in January and March.

[5] Temperature at a subset of sites.

[6] Collected monthly from June to October.

[7] Fish fence constructed using two small mesh fyke nets.

[8] Spring fish fence operational for four days due to high water levels and flows.

[9] Spring fish fence operational for ten days due to ice cover followed by high flows that further delayed the install.

Table 1.2 Average fish production (g/yr) estimates[1] for habitat losses due to the Project, by species and area.

Species	Calumet River	Tar River	Calumet and Tar River Tributaries[2]	Total
BRST	6,397	6	12,420	18,823
FTMN	1,779	69	9,477	11,325
LKCH	2,761	56,619	5,134	64,514
LNSC	10,817	298,640	53,853	363,310
PH sp[3]	7,624	627	45,507	53,758
SLSC	172	27,144	0	27,316
WHSC	244,390	466,660	21,320	732,370
Total	**273,940**	**849,765**	**147,711**	**1,271,416**

[1] Production estimates were calculated from baseline data collected from 2006 to 2010 (Golder 2013a).

[2] Tributary locations are provided in Figure 1 of Golder 2013a.

[3] Northern redbelly dace and finescale dace were grouped to the genus level *Phoxinus* spp.

1.3.1 2018 Monitoring Program Objectives

The primary objective of the 2018 Program was to develop scientifically-defensible fish population and annual fish productivity estimates for Horizon Lake. Secondary objectives of the Program were to assess the lake's ecological function and progression through analysis of its chemical, physical, and biological attributes, and to monitor fish movement and use of the upper Tar River.

Additional studies conducted by Canadian Natural and Stantec Consulting Ltd. (Stantec) in 2018 have been summarized in this report to provide a comprehensive overview of all work that was undertaken in 2018 to characterize Horizon Lake. These studies included a fish compensation habitat monitoring program on the upper Tar River and an eDNA study on the upper Tar River and Horizon Lake.

The primary objective of the 2018 fish compensation habitat monitoring was to assess habitat conditions for Arctic grayling within the upper Tar River and determine if the habitat compensation encouraged the establishment of an Arctic grayling population within the Tar River and Horizon Lake. This was done by monitoring:

- Beaver activity in and around the rock weir;
- Physical condition of the weir;
- Habitat characteristics throughout the weir;
- Seasonal use by Arctic grayling within the weir;
- Seasonal use by Arctic grayling outside the weir; and
- Seasonal use by other fish species within the weir.

The objective of the eDNA study was to detect the presence of Arctic grayling and burbot (BURB; *Lota lota*) within the Tar River and Horizon Lake using eDNA sampling, and to assess whether this method may be a useful tool for ongoing biomonitoring programs at Horizon Mine.

2.0 METHODS

2.1 FIELD DATA COLLECTION

The 2018 Program included sampling tasks designed to assess key indicators of ecosystem health and pre-cursors for biological colonization, and to directly quantify the biota currently present in Horizon Lake. Sampling tasks included:

- Fall and winter water quality sampling for conventional variables, major ions, nutrients, chlorophyll-*a*, biological oxygen demand, phenolics, naphthenic acids, and total and dissolved metals;
- Deployment of continuous-record data loggers equipped to measure water temperature and dissolved oxygen throughout the year;
- Quarterly depth profiles of temperature, dissolved oxygen (DO), conductivity, and pH;
- Collections of phytoplankton and zooplankton in spring, summer, and fall;
- Spring deployment of an underwater camera, fyke nets, and minnow traps;
- Spring snorkel survey on the upper Tar River;
- PIT tagging of Arctic grayling, white sucker, and longnose sucker;
- Operation of two passive integrated transponder (PIT) tag antennae on the upper Tar River;
- Fall sampling of benthic macroinvertebrates and sediment quality;
- Fall sampling of fish populations using gill nets, fyke nets, boat electrofishing, and minnow traps;
- Fall sampling of fish tissues for total metals, organics, and total and methyl mercury;
- Fall hydroacoustic survey of fish populations in Horizon Lake; and
- Fall eDNA sampling to test for the presence of ARGR and BURB (conducted by Stantec).

Photos were taken at all permanent sampling sites (HZL-1 to HZL-9) in each of the four cardinal compass directions during each of the seasonal sampling events. Additional photographs of shoreline vegetation, wildlife, voucher specimens, and sampling methods were also collected. Representative photographs are provided in Appendix A3.

2.1.1 Water Quality

2.1.1.1 Dataloggers

Temperature loggers were installed at the water surface and at one-meter intervals through the water column at site HZL-1 (Table 2.1 and Figure 2.1). Dissolved oxygen loggers were also installed at site HZL-1, at 5 m and 10 m depths. Temperature and DO observations were collected at 15-minute intervals and loggers were downloaded during regularly scheduled visits to the lake.

2.1.1.2 In Situ Water Quality Monitoring

Quarterly water quality profiles were collected at the three pelagic monitoring sites on Horizon Lake (HZL-1 through HZL-3; Table 2.1 and Figure 2.1). The profile data included in situ measurements of DO (±0.01 mg/L), water temperature (± 0.01 °C), pH (± 0.01 pH units), and specific conductivity (± 0.01 µS/cm) at 1-m depth intervals using a pre-calibrated multi-probe YSI meter. Dissolved oxygen measurements were also collected from the lake surface using a LaMotte portable Winkler titration kit to confirm the accuracy of the meter readings. The profiles were used to determine whether the lake was thermally stratified during each sampling event.

In situ water quality variables were also measured at the lake surface for the three littoral and three near-shore monitoring sites (HZL-4 through HZL-9; Table 2.1 and Figure 2.1), using a YSI multi-meter. DO concentrations were measured by Winkler titration to confirm the accuracy of meter readings.

Secchi depth measurements were recorded at each pelagic site to estimate the depth of the euphotic zone. The maximum depth observable was measured on the descent and ascent of the disc though the water column; the two depths were then averaged to provide the Secchi depth for each site.

2.1.1.3 Analytical Sample Collection

Water samples were collected from Horizon Lake for laboratory analysis during the fall of 2018 (Sept 6) and winter of 2019 (Feb 21 and 22). Sub-samples were collected from the three pelagic monitoring sites (HZL-1 through HZL-3) and combined to make one lake composite sample. At each site, water was collected from two depths within the euphotic zone (1 m below the surface and near the bottom of the zone) and deposited into a clean white pail, ensuring that equal volumes of water from each site were added to the bucket. The euphotic zone depth was estimated as two times the secchi depth. Once grabs from all three sites were composited into the bucket, the water was transferred to the sample bottles and preserved (as required).

Samples were collected using a Kemmerer sampler, which was cleaned with metal-free soap and triple rinsed with lake water prior to the collection of water quality samples.

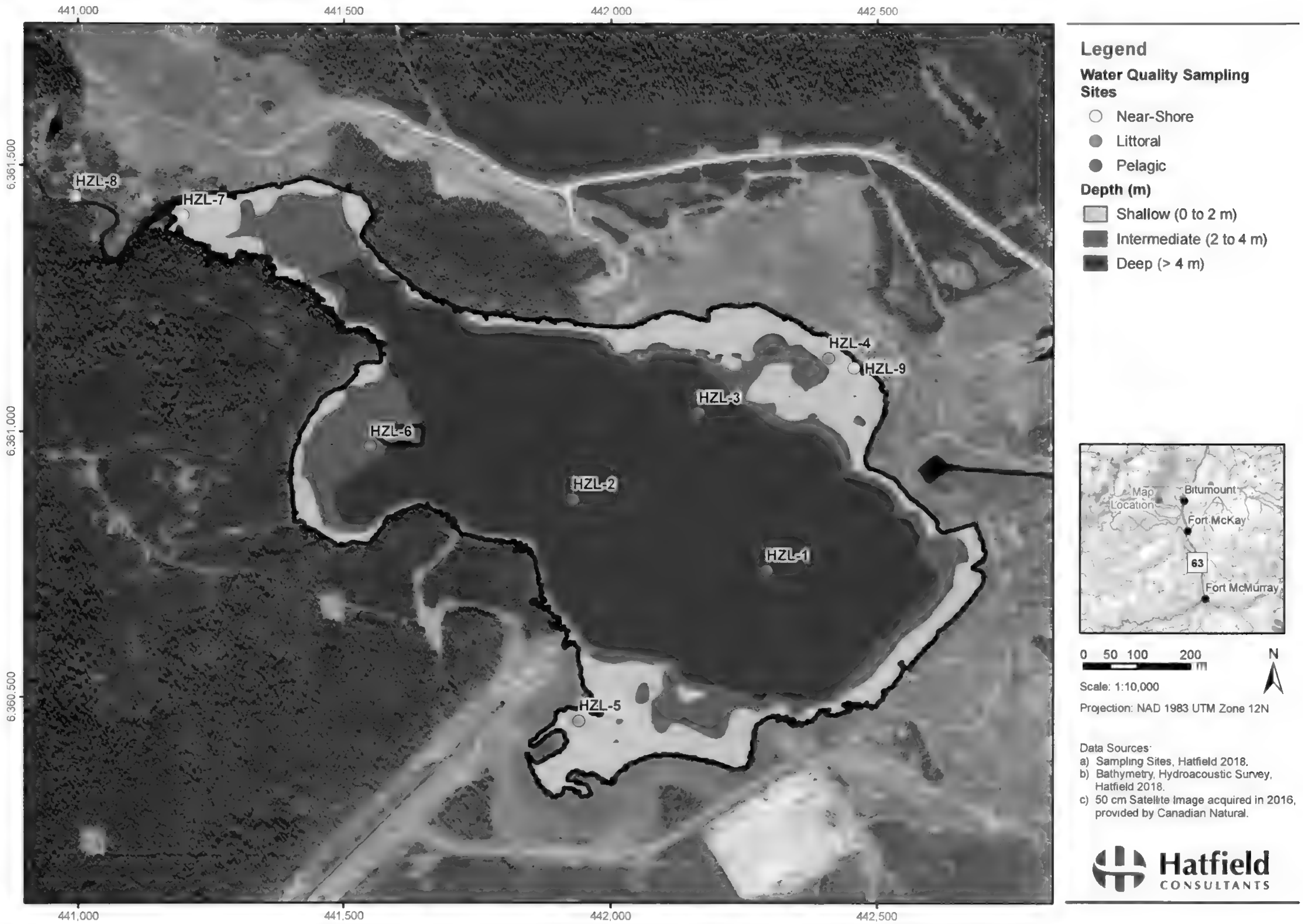
QA/QC procedures included the collection of one field blank and one split sample for each sampling event. All QA/QC and lake water samples were analyzed for the full suite of analytical variables listed in Table 2.2. Laboratory analyses were completed by Maxxam Analytics Inc.

Table 2.1 Water quality profile and water chemistry sampling sites, 2018.

Site Name	UTM Coordinates (NAD 83, Zone 12)		Habitat Type	Activity	Sampling Dates
	Easting	Northing			
HZL-1	442292	6360738	Pelagic	In situ profile, chemistry, data logger	May 16, Jul 10, Sept 4, Sept 6[a], and Oct 6, 2018; Feb 21 and 22, 2019[a]
HZL-2	441929	6360872	Pelagic	In situ profile, chemistry	May 16, Jul 10, Sept 4, and Sept 6[a], 2018; Feb 21 and 22, 2019[a]
HZL-3	442165	6361035	Pelagic	In situ profile, chemistry	May 16, Jul 10, Sept 4, and Sept 6[a], 2018; Feb 21 and 22, 2019[a]
HZL-4	442408	6361138	Littoral	In situ surface	May 16, Jul 10, Sept 4, 2018
HZL-5	441940	6360455	Littoral	In situ surface	May 15, Jul 10, Sept 4, 2018
HZL-6	441550	6360972	Littoral	In situ surface	May 15, Jul 10, Sept 4, 2018
HZL-7	441196	6361406	Near-Shore	In situ surface	May 15, Jul 10, Sept 4, 2018
HZL-8	440995	6361441	Near-Shore	In situ surface	May 16, Jul 10, Sept 4, 2018
HZL-9	442456	6361120	Near-Shore	In situ surface	May 16, Jul 10, Sept 4, 2018

[a] Water chemistry sampling dates

Figure 2.1 Water quality profile and water chemistry sampling sites on Horizon Lake, 2018.



Horizon Lake Monitoring Program 2018

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Table 2.2 Physical and chemical variables measured in water samples collected from Horizon Lake, 2018.

Group	Water Quality Variable	
Conventional Variables	True Colour	Total alkalinity (PP and Total)
	Dissolved organic carbon	Total dissolved solids
	pH	Total hardness
	Specific conductance	Total organic carbon
	Anion Sum	Total suspended solids
	Cation Sum	
Major Ions	Bicarbonate	Ion balance
	Carbonate	Sulphate
	Chloride	Sulphide (as H2S and total)
	Hydroxide	
Nutrients and BOD	Nitrate+nitrite	Total nitrogen
	Ammonia nitrogen	Phosphorus – total
	Biological oxygen demand	Phosphorus – dissolved
	Total Kjeldahl nitrogen	Nitrate
	Chlorophyll-a	Nitrite
Organics	Naphthenic acids	Total phenols
	Total petroleum hydrocarbons	
Total and Dissolved Metals	Aluminum (Al)	Molybdenum (Mo)
	Antimony (Sb)	Nickel (Ni)
	Arsenic (As)	Phosphorus (P)
	Barium (Ba)	Potassium (K)
	Beryllium (Be)	Selenium (Se)
	Boron (B)	Silicon (Si)
	Cadmium (Cd)	Silver (Ag)
	Calcium (Ca)	Sodium (Na)
	Chromium (Cr)	Strontium (Sr)
	Cobalt (Co)	Sulphur (S)
	Copper (Cu)	Thallium (Tl)
	Iron (Fe)	Tin (Sn)
	Lead (Pb)	Titanium (Ti)
	Lithium (Li)	Uranium (U)
	Magnesium (Mg)	Vanadium (V)
	Manganese (Mn)	Zinc (Zn)
	Mercury (Hg)	

2.1.2 Sediment Quality

Sediment samples were collected from nine sampling sites (BEN-1 to BEN-9; Table 2.3 and Figure 2.2) on September 4 and 5, 2018, in conjunction with the benthic invertebrate sampling program. Each sample was comprised of a composite of grabs, repeated until the total volume reached approximately 1.5 L and collected with a 15cm x 15cm Ekman grab (0.023 m^2 sampling area). To minimize potential cross-contamination, pans, spoons, and the dredge were cleaned with a metals-free soap, rinsed with hexane, rinsed with acetone, and triple-rinsed with ambient water prior to sample collection at each site. Each grab sample was checked to make sure it did not contain any large foreign objects, and that the jaws had closed completely. Successful grabs were transferred to a stainless-steel pan until a sufficient volume had been collected for analysis. The sediments were then homogenized in the pan using a stainless-steel spoon and transferred into sterilized glass jars for chemical analyses and sealable plastic bags for particle size and total organic carbon (TOC) analyses. Each container was labeled with the site name, collection date and time, and the analysis requested, which were accompanied with a completed chain-of-custody (CoC) form. All chemical and physical analyses were conducted by Maxxam Analytics Inc. (Calgary, AB), except PAHs, which were analyzed by AXYS Analytical Services Ltd (Sydney, BC).

2.1.3 Phytoplankton and Zooplankton

Phytoplankton and zooplankton samples were collected in conjunction with water quality sampling at sites HZL-1, HZL-2, and HZL-3 (Table 2.1) on May 16, July 10, and September 6, 2018.

One composite water sample was collected for phytoplankton analysis from each pelagic site using a Kemmerer sampler. Each composite sample consisted of three Kemmerer hauls, with one collected from the surface (0.2-0.3 m depth), one from the middle (0.5 to 1.0 m depth), and one from the maximum depth of the euphotic zone, which ranged from 1.0 to 2.2 m across the lake and between seasons. Each grab was transferred to a clean 19-L polyethylene bucket to create the composite sample. Water was then transferred to a 1-L sample bottle and preserved with approximately 15 drops of Lugol's solution. Each container was labeled with the site name, collection date and time, and analysis requested.

Zooplankton samples were collected from three pelagic sites using a 0.30 m diameter, 80 µm mesh Wisconsin net. Samples were collected through the euphotic zone of each site (range 1.0 to 2.2 m) by deploying the net to the bottom of the euphotic zone and vertically retrieving it at a continuous rate of approximately 0.5 m/s. At the surface, the outer sides of the net were rinsed with lake water to remove clinging plankton, and the sample was drained into a 500-mL sample container. A second haul was then completed using the same technique, resulting in a composite sample comprised of two vertical net hauls from each site. Soda water was used to anesthetize the biota before preserving with ethanol. Total sample volume was approximately 250 mL (100 mL of lake water, 50 mL of ethanol, and 100 mL of soda water). Each container was labeled with the site name, collection date and time, and analysis requested.

All phytoplankton and zooplankton samples were couriered to Dr. Michael Agbeti at Bio-Limno Research and Consulting Inc. (Halifax, NS) for taxonomic identification and enumeration.

2.1.4 Benthic Invertebrates

Benthic invertebrate samples were collected from mid-lake, littoral, and near-shore zones of Horizon Lake on September 4 and 5, 2018 (Table 2.3 and Figure 2.2). The mid-lake zone has been defined as >2.5 m water depth; the littoral zone as between 2.5 and 1.0 m water depth; and the near-shore zone (within the littoral zone) as <1 m water depths. The littoral zone of Horizon Lake is typically defined as ≤2.5 m, hence the clarification between littoral and near-shore zones. Sample site abbreviations and their corresponding GPS coordinates are provided in Table 2.3. A visual representation of sampling coverage across the lake is shown in Figure 2.2.

Sampling utilized standard methods described by Alberta Environment (AENV 1990), Environment Canada (1993), Klemm et al. (1990), and Rosenberg and Resh (1993). An Ekman grab sampler (0.023 m^2 sampling area) was deployed using a rope and messenger to collect benthic invertebrate samples. Samples were sieved in the field using a 250-µm screen box-sieve, preserved in 10% buffered formalin, and bottled for transport.

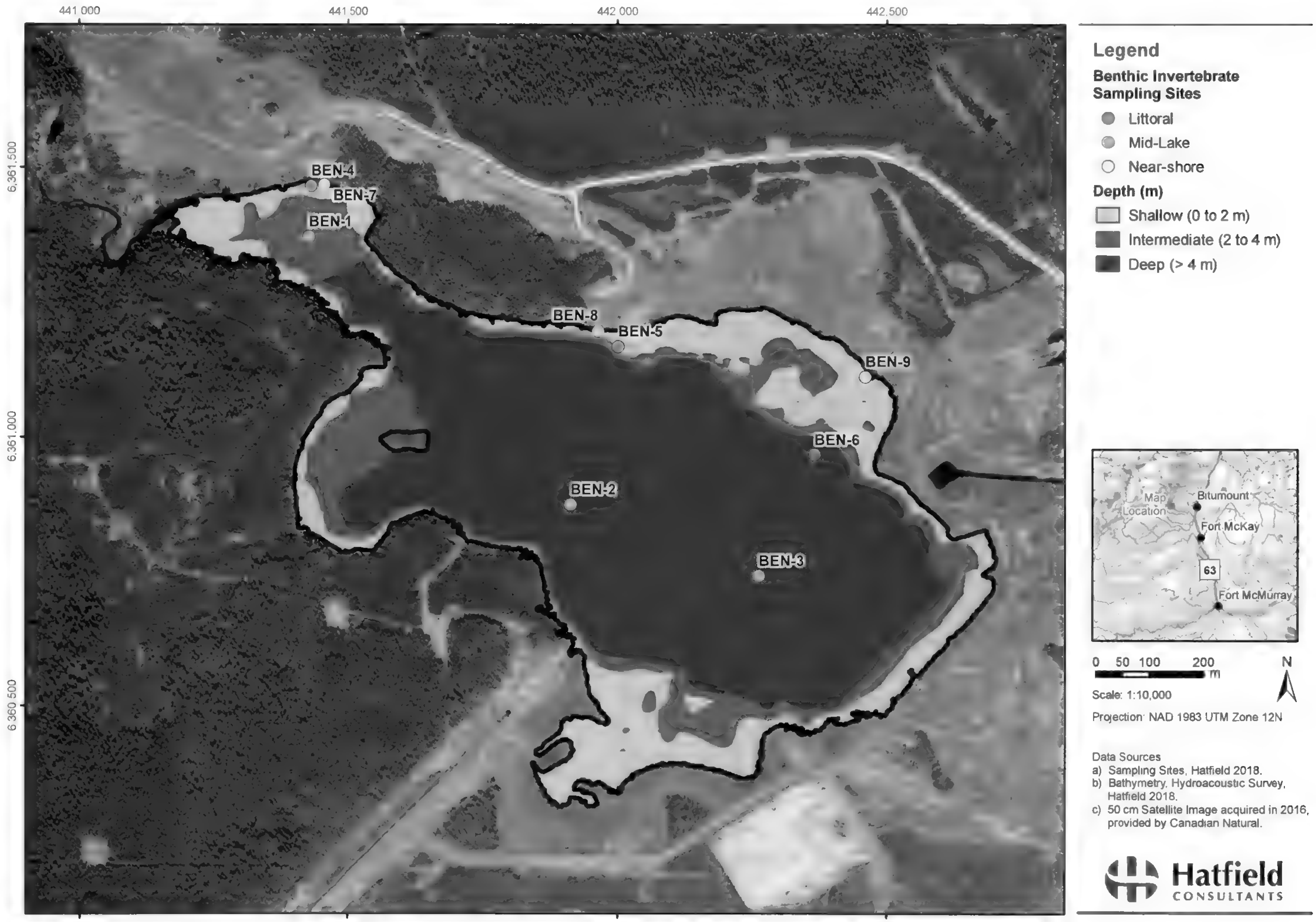
Each container was labeled with the site name, collection date and time, and analysis requested. Taxonomic identifications were conducted by Dr. Jack Zloty in Summerland, BC. Benthic invertebrates were generally identified to the lowest practical taxonomic level (i.e., genus/species). Exceptions included: aquatic worms (Oligochaeta), which were identified to subfamily; seed shrimps (Ostracoda), water mites (Hydracarina), roundworms (Nematoda), and moths and butterflies (Lepidoptera), which were identified to the major taxonomic group; and copepods (Copepoda), which were identified to family level. Analyses followed methods outlined by Environment Canada (2010, 2014).

Table 2.3 Benthic invertebrate sampling sites on Horizon Lake, September 2018.

Site Name	Site Names in Previous Years[a]	UTM Coordinates (NAD 83, Zone 12)		Habitat Type
		Easting	Northing	
BEN-1	HL-1	441424	6361372	Mid-Lake
BEN-2	HL-2, HZL-B	441913	6360873	Mid-lake
BEN-3	HL-3, HZL-A	442263	6360741	Mid-lake
BEN-4	HL-4	441429	6361466	Littoral
BEN-5	HL-5	442001	6361168	Littoral
BEN-6	HL-6, HZL-E	442366	6360967	Littoral
BEN-7	HL-7	441453	6361468	Near-shore
BEN-8	HL-8, HZL-F	441964	6361197	Near-shore
BEN-9	HL-9, HZL-G	442460	6361112	Near-shore

[a] Site names in Golder 2009, 2010, 2011a, 2012, 2013b, 2014, 2015.

Figure 2.2 Benthic invertebrate sampling sites on Horizon Lake, September 2018.



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2.1.5 Fish

2.1.5.1 Tar River Spring Spawning Migration

Two small-mesh fyke nets (5 mm mesh size) and four to seven minnow traps were installed for nine days near the upper PIT antenna on the upper Tar River (near the location of previous fish fences). Fyke nets and minnow traps were checked twice daily while in operation. All captured fish were identified to species, weighed (±0.1 g), measured for length (±1 mm), and checked for the presence of tags (PIT and fin punches). Date and time of capture were recorded for each fish. When discernable from external examination, life stage, sex, and reproductive status of large-bodied fish were also recorded.

BURB, WHSC, and LNSC greater than 130 mm fork length and ARGR greater than 75 mm fork length were marked with a PIT tag to ensure the individual could be identified during future captures, and to track their movements between Horizon Lake and the upper Tar River. PIT tags were inserted into the abdominal cavity of the fish using an MK25 implant gun. Tag injectors were disinfected in ethanol before each fish received an implant. After tagging, the insertion point was sealed with tissue adhesive and the fish was placed in an aerated recovery tank prior to its release.

Non-lethal ageing structures (fin rays) were taken from WHSC and LNSC that measured more than 150 mm, according to methods described in MacKay et al. (1990). A maximum of 15 structures were collected for each species (Table 2.4). Fin rays were placed in scale envelopes labeled with a unique numerical ID, the date, trap ID, species, length, and weight, and shipped to North/South Consultants (Winnipeg, MB) for age determination.

Table 2.4 Number of fin rays collected from WHSC and LNSC, spring 2018.

Size Class (mm)	Adult WHSC	Adult LNSC
150-250	4	2
251-350	7	11
351-450	4 [a]	0

[a] One ageing structure was collected from a fish measuring 455 mm.

Measurements of in situ water temperature (±0.1°C), pH (±0.1 pH units), and specific conductivity (±1.0 µs/cm) were taken daily using a Hanna handheld pH/conductivity probe. In situ dissolved oxygen levels (±0.1 mg/L) were measured at the same frequency, using a LaMotte Winkler titration kit. Habitat observations were also collected and included: stream stage (dry, low, moderate, high, flood), wetted width, rooted width, maximum depth, and the proportion of pools, riffles, and runs.

Snorkel surveys were used to visually assess species assemblages, fish distribution, fish abundance, and habitat use in the upper Tar River. Snorkel surveys were conducted upstream of Horizon Lake. Observations were specific to mesohabitat types (riffles, pools, and runs), with the following recorded at each mesohabitat unit: number of fish observed (for each species); presence of eggs or other spawning indicators; time, date, and UTMs; wetted width; max depth; and substrate. Supplemental observations were also recorded (e.g., flow, visibility, presence of periphyton, riparian cover, etc.).

There are currently two PIT tag antennae arrays operated on the upper Tar River. The first is located approximately 250 m upstream of Horizon Lake and the second is approximately 380 m upstream of the lake. The antennae were used to document year-round presence and movement of tagged fish within the upper Tar River.

Following the 2017 program, it was recommended that a DIDSON sonar unit be deployed to monitor spring movements of fish. The DIDSON was to be leased from DFO but was not available at the time of the survey. A Biotactic underwater camera was deployed for the duration of the spring program in 2018 to collect supplemental information.

Tar River Fish Compensation Habitat Monitoring

The Tar River fish compensation habitat monitoring was conducted by Canadian Natural site staff from 2012 to 2018. The following methods section was written by Canadian Natural's environmental coordinator, for inclusion in this technical report.

Beaver Activity

Beaver activity was monitored monthly during the open-water season from 2013 to 2018 in the habitat around the rock weir (Appendix A2 Figure 1).

Condition of the Rock Weir

The structural integrity of the rock weir was monitored on a yearly basis since it was built in 2012. This was completed by monitoring:

- Snow depth;
- Water levels at S34 hydrometric station located upstream of the constructed habitat (440745 E 6361662 N; Appendix A2 Figure 2);
- Rainfall accumulation from the C2 climate station (443364 E 6360510 N; Appendix A2 Figure 2); and
- Water elevation in Horizon Lake.

The C2 and S34 monitoring stations were originally part of the Regional Aquatics Monitoring Program (RAMP) and are now part of the Oil Sands Monitoring (OSM) Program.

In the 2018 visual inspections were conducted weekly during freshet to ensure no movement of the boulders occurred.

Revegetation

Photos were taken to assess revegetation growth.

Overwintering Habitat

Ice thickness, in-situ water quality, and water depth were measured monthly in winter 2018. Samples were taken on the left bank (west side), center, and right bank (east side) downstream of the weir.

Water Quality

A YSI EXO 2 data sonde was deployed below the weir in the scour pool habitat during open water season. The data sonde monitored temperature, pH, dissolved oxygen (DO), conductivity, and turbidity at 1 hour intervals. Deployment and demobilization varied annually and were dependent on ice formation in the river. Data logging in 2018 occurred between May 16 and October 5. Additionally, three TidBit temperature loggers were deployed in the fall of 2018 to continuously record the temperature through the winter. The loggers were place at the lower and upper PIT antenna, and in the constructed weir in an attempt to obtain a complete record of the water temperature year-round with emphasis on early spring, prior to the EXO 2 data sonde deployment.

Velocity and Depth

Velocity and depth measurements were taken monthly during open water months, when safe conditions were present. Measurements were taken with a Model 3000 Swoffer Flow Meter at 12-meter intervals upstream and downstream of the weir. Measurements began at the downstream antenna, approximately 100 meters below the weir, with an endpoint approximately 96 meters above the weir. Measurement methodology changed in 2017, with samples taken at 6/10 water depth when possible (Swoffer Instruments, 2011), with five measurements taken across the width of the river at equal intervals to obtain a representative sample of the transect. These measurements were then averaged to obtain the result for each monitoring location.

Habitat Mapping

A habitat map of the Tar River, ranging 100 meters upstream and downstream of the constructed compensation habitat, has been produced annually since 2013. The habitat features were characterized as defined by the Fish Habitat Manual: Guidelines and Procedures for Watercourse Crossings in Alberta, Table 4-2: Small River or Stream Habitat Classification and Rating System (Government of Alberta 2009; summarized in Appendix A2 Table 1).

The habitat survey was completed in the last week of July to the first week of August each year to attempt to reduce environmental variability for flow and vegetation. A grid of rope with indicators every meter was connected to a T-bar and inserted into the substrate in 20-meter segments facing directly upstream to produce a sampling grid. The starting point was located at the rock weir, having a consistent starting location. Habitat features were determined per square meter and were recorded via illustration on graph paper. Measurements of bank width were taken every 5 meters. The illustrations were scanned, connected in Photoshop, and the map was produced. Due to sampling methods and individual variability of perception for habitat characteristics, the map changed year to year (e.g., the river appears to have extreme meandering, although the river has not noticeably meandered). The sampling methods are being refined to attempt to decrease variability, such as the use of GIS resources.

Improvements have been made to the map since the report submission in 2015; additional habitat types were added to reflect more detailed definitions of habitat. This can be seen in the Tar River habitat map and comparison of 2013-2018 in Appendix A2 Figure 19: Tar River Habitat Map Comparison 2013-2018.

Fishing Use

Sampling in 2015 and 2018 monitoring years was completed as outlined in the Fish Compensation Habitat Monitoring, May 2013. This included utilization of a fish fence, fyke nets, and minnow traps in the spring, while backpack electrofishing with block nets were used in the summer and fall. The fish fence was removed from the sampling methods in 2018 as per letter 01-HCAA-CA1-00477 from Fisheries and Oceans Canada due to impeded fish movement and increased predation. Additionally, in 2018, angling and snorkel surveys were conducted in the spring. Spring sampling was completed as part of the Horizon Lake Monitoring Program, including the snorkel surveys, BioTactic underwater camera, fyke netting, and minnow trapping. Angling was only completed one day during spring below the habitat in 15-minute partitions for sections of the habitat, consisting of fly fishing with both wet and dry flies. Once per month, two fyke nets were set for maximum 24 hours overnight with one fishing upstream and the other downstream. Electrofishing was completed once per month with a crew of two in approximately 100-meter segments with block nets. Settings were dependent on water conditions and fish response. Spawning and schools of juveniles were seen in spring 2018, thus no electrofishing activity was conducted until after July 15, 2018 as per condition in FRL 18-0411. Electrofishing and fyke netting did not occur in the Tar River in October due to high precipitation and low temperatures making for unsafe work conditions.

During sampling events, all species were identified, enumerated, and fork length and weight recorded. After 100 individuals of a single species during a sampling event, a count was completed. All white and longnose sucker above 130 mm in length and Arctic grayling above 75mm in length were tagged with a PIT tag.

2.1.5.2 Fish Health

Monitoring of fish health was undertaken concurrently with the fall hydroacoustic program (see section 2.1.5.3 for additional field data collection methods). The objective of this study component was to collect muscle tissue samples for measurement of total mercury, methyl mercury, total metals, and organic compound concentrations in fish.

Fish tissue samples were collected from study and references sites (coordinates provided in Appendix A4), which included:

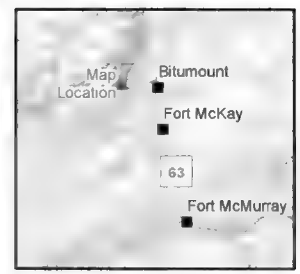
- Horizon Lake from October 3 to 11, using boat electrofishing, baited minnow traps, baited fyke nets, and gill nets (Figure 2.4); and
- Calumet River on October 2, using backpack electrofishing (Figure 2.5).

Baited minnow traps were deployed overnight in Calumet Lake on October 2 and 3 (Figure 2.5); however, no target species were captured for tissue sampling.

Figure 2.3 Snorkel survey sampling sites on Tar River and Horizon Lake, spring 2018.

Legend

o Habitat Unit



0 100 200 m

N

Scale 1:11,000

Projection: NAD 1983 UTM Zone 12N

Data Sources:
a) Survey Locations, Hatfield 2018.
b) Base Data from 1 50k Canvec.
c) 50 cm Satellite Image acquired in 2016, provided by Canadian Natural.

Hatfield CONSULTANTS

Horizon Lake Monitoring Program 2018

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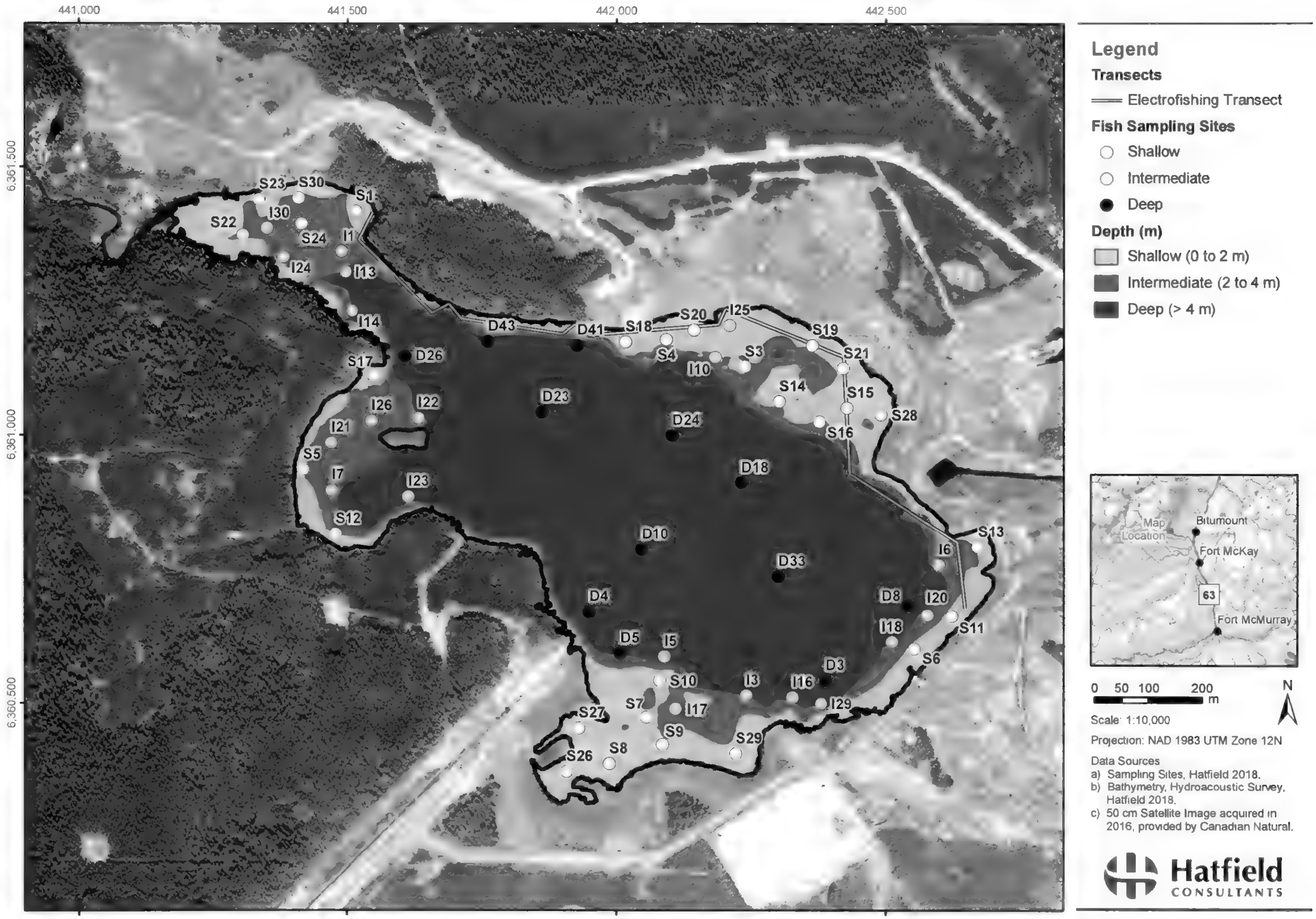
Figure 2.4 Fish sampling sites on Horizon Lake, October 2018.



Horizon Lake Monitoring Program 2018

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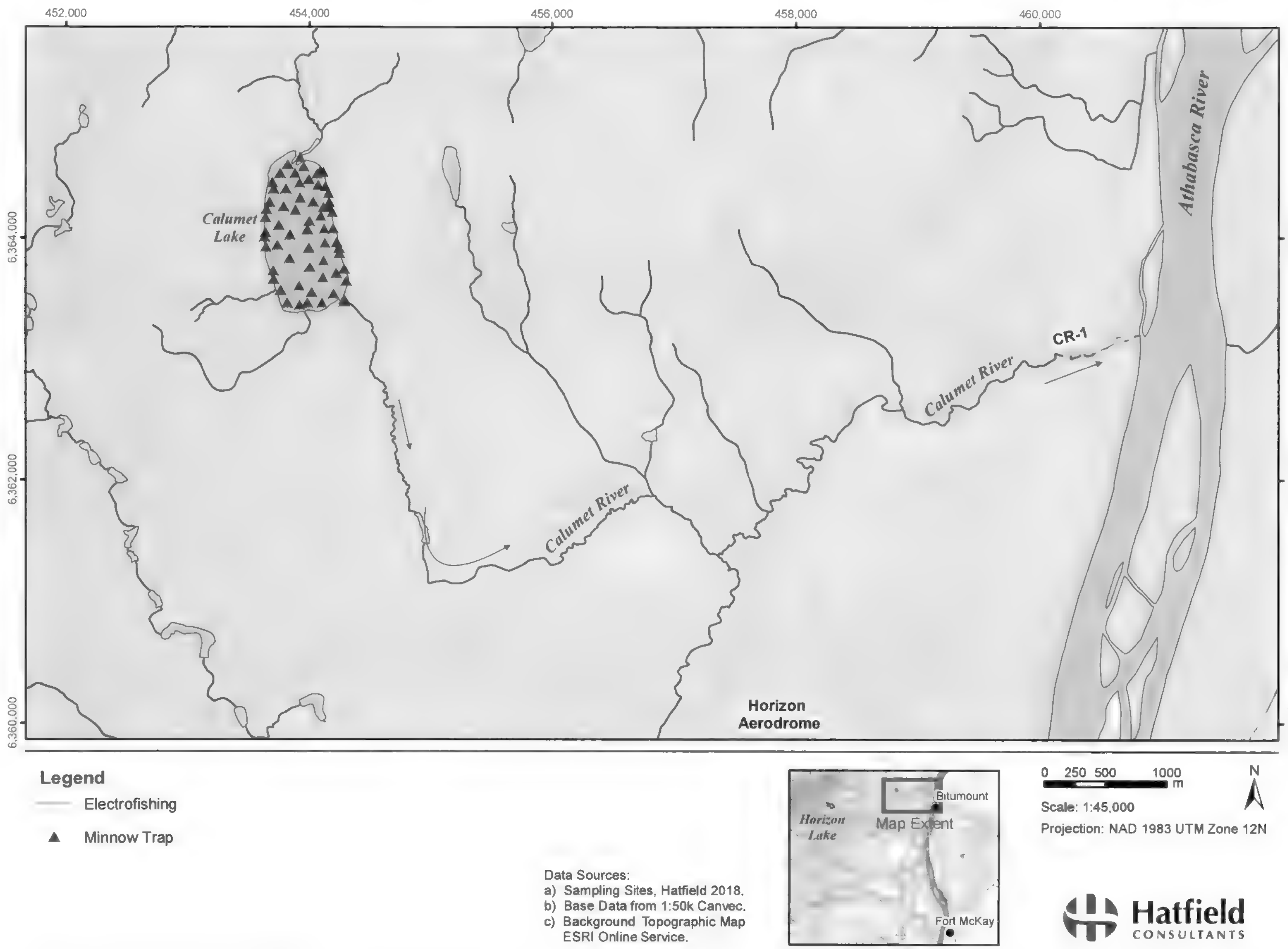
Figure 2.5 Fish tissue sampling sites on Calumet Lake and Calumet River, October 2018.



Horizon Lake Monitoring Program 2018

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Whole-body Tissue Sampling

Whole-body composites were collected from FTMN (60-70 mm), LKCH (90-120 mm), and juvenile WHSC (80-100 mm) for total mercury, methyl mercury, metals, and organics analyses (Table 2.5). Individuals were sacrificed until a combined minimum whole-body weight of 5 g was collected for each target species for total and methyl mercury analysis and a minimum whole-body weight of 30 g was collected for each target species for metals and organics analysis. The individual samples comprising each composite were placed into a glass jar and submitted to the lab for homogenization. Samples were kept on dry ice in the field and then transferred to an on-site freezer until they were delivered on-ice to the lab depot in Fort McMurray.

The objective for Calumet Lake and Calumet River was to collect whole-body fathead minnow, juvenile white sucker, and lake chub composites for analysis of metals, organics, and mercury/methyl mercury. No target species were captured in Calumet Lake in 2018, while enough juvenile white sucker samples were collected from Calumet River to complete all planned analyses; the number of lake chub collected were only sufficient to complete metals and organics analyses. All planned whole-body composites were collected from Horizon Lake.

Muscle Tissue Filets

Muscle tissue filets were collected from adult WHSC from three target size classes (200-250 mm, 251-300 mm, and 301-350mm) for total mercury, methyl mercury, metals, and organics analyses (Table 2.5). Collections of tissues were completed on a clean, stainless-steel pan. All dissecting equipment and trays were cleaned and sterilized before and after each dissection using the following steps: distilled water rinse, metals-free detergent wash, distilled water rinse, hexane rinse, acetone rinse, and air dry. Non-chlorinated, non-powdered latex gloves were worn during equipment cleaning, and changed prior to starting dissections.

Lethal fish tissue samples were collected as follows:

- The fish was placed on a cleaned stainless-steel surface.
- An external health assessment was completed.
- For the largest length class, muscle samples were collected from above the lateral line; for the smaller length classes, muscle samples were collected from above and below the lateral line. Skin and bone were first removed from the muscle tissue.
- A small amount of tissue (approximately 1 g) was placed into a cryovial for total and methyl mercury analysis. The remaining tissue was placed into a glass jar until a minimum of 30 g was collected for metals and organics analyses.
- Each sample was marked with the species ID, location of capture, sampling date, and the type of analyses requested (i.e., total and methyl mercury or metals and organics).
- Following tissue collections, an internal fish health assessment was conducted on each sacrificed fish. This included an internal pathology examination.
- Sagittal otoliths were collected from each sacrificed fish and sent to North/South Consultants for age determination.

Tissue samples were stored on dry ice in the field and then transferred to an on-site freezer. Samples for metals and organics analysis were placed on ice and delivered to the ALS Environmental Depot in Fort McMurray; samples for total and methyl mercury analysis were placed on dry ice and couriered to Flett Research (Winnipeg, MB).

Eight of nine planned white sucker lethal tissue samples were collected from Horizon Lake, consisting of 8 lethal samples for metals and organics (plus one QAQC sample), and 8 total mercury/methyl mercury samples (plus one QAQC sample). The one missing sample was the result of insufficient captures from the largest length class (301-350 mm).

Table 2.5 Summary of species, sample numbers, and sample types for Horizon Lake and Calumet watershed fish tissue analyses, October 2018.

Analysis	Location	Size Class	Adult WHSC	FTMN	Juvenile WHSC	LKCH	QA/QC Duplicate Samples
Lethal Metals/ Organics/Mercury	Horizon Lake	200-250 mm	3	-	-	-	1
		251-300 mm	3	-	-	-	
		301-350 mm	2	-	-	-	
	Horizon Lake and Calumet watershed	60-70 mm	-	1 composite (whole-body)	-	-	-
		80-100 mm	-	-	1 composite (whole-body)	-	-
		90-120 mm	-	-	-	1 composite (whole-body)	-

Note: The number of fish in each composite varied based on the mass requirement (30 g for metals and organics, 5 g for mercury) for each set of analyses.

2.1.5.3 Fish Production Estimates

Hydroacoustic Survey

Biosonics Inc. performed a mobile hydroacoustic assessment comprised of two nighttime surveys on October 10 and 11, to provide a fish population estimate for Horizon Lake. A total of 21 parallel transects spaced approximately 50 m apart and spanning the entire lake were assessed for each of the surveys. Specific details regarding hydroacoustic instrumentation, installation, and methods are discussed in the BioSonics hydroacoustic report provided in Appendix A5. Methods applied were the same as surveys conducted from 2015 to 2017 (Hatfield 2016, 2017, 2018).

A concurrent bathymetry survey of Horizon Lake was completed by collecting depth data along the 21 hydroacoustic transects. The survey was completed using a GPS-enabled depth sounder affixed to the boat transom. The depth data were transferred to an ArcGIS 10.2™ environment for development of a bathymetric map, which is provided as a backdrop to each of the Horizon Lake sampling location maps (Figure 2.1, Figure 2.2).

Fish Capture Program

The objective of the fish capture program was to collect a sufficient number of fish to develop reliable estimates of species composition within the deep (>4m), intermediate (2 to 4 m), and shallow (<2 m) depth strata defined for the hydroacoustic survey (Figure 2.4). Sampling sites were randomly selected within each strata. Site coordinates and fishing efforts are provided in Appendix A4.

A combination of fyke netting, gillnetting, boat electrofishing, and minnow trapping was employed to capture fish over the course of the fish sampling program, which extended from October 3 to 11, 2018. The objective of the program was to maximize the number of sites sampled in each of the three sampling strata (shallow, intermediate, and deep) to fully characterize the species and size classes of fish present in the lake. A total of 28 shallow, 20 intermediate, and 12 deep sites were sampled (Figure 2.4), with boat electrofishing conducted along approximately 1,360 m of the lake perimeter.

Two fyke nets were set each day and left to soak for a period of 24 hours. The nets were then retrieved, the fish were removed for processing, and the nets were redeployed at a new sampling site. Five baited minnow traps were set overnight at each site, with a maximum of 30 traps set per day. Minnow traps were set for a maximum of 24 hours, checked, and then repositioned. Boat electrofishing was conducted along approximately 200 m transects positioned around the lake perimeter (Figure 2.4), using a Smith-Root GPP 2.5 portable electrofisher with dual boom arrays and one dip-netter. Electrofishing settings were: 80% power, 60 DC, and 5 amps. Gillnetting consisted of the deployment of scientific, multi-panel (25 mm, 38 mm, 51 mm, 64 mm, 76 mm, 102 mm, 127 mm, and 152 mm mesh sizes) or single panel (38 mm mesh size) nets. Nets were set, checked, and moved to a new location every two hours. A variety of surface, sinking, and mid-column nets were deployed. Summaries of fyke netting, minnow trapping, electrofishing, and gillnetting efforts are provided in Appendix A4.

Fish Processing

All individuals were measured for length (±1 mm) and weight (±0.1 g), and assessed for maturity and sex, based on an external examination. All captured fish were examined for historical fin punches (large-bodied fish) or fin clips (small-bodied fish) and if present, recorded as a recapture.

PIT Tagging Procedures

All captured large-bodied fish greater than 75 mm were examined for existing PIT tags upon capture. All untagged ARGR greater than 75 mm in fork length received a PIT tag, while the minimum tagging length for all other large-bodied fish species was 130 mm. Tag codes were recorded on datasheets and stored electronically in the scanner and downloaded at the end of the field program.

Fish Ageing Procedures

Non-lethal ageing structures were taken from various length classes of ARGR, FTMN, LKCH, WHSC, and LNSC captured from Horizon Lake (Table 2.6). Ageing structures were collected as follows:

- LNSC, WHSC, FTMN, and LKCH: the leading three rays from the left pectoral fin were collected; and
- ARGR: scales were collected from above the lateral line and posterior to the dorsal fin.

Pectoral fin rays were also collected from five juvenile WHSC (80-100 mm) and five LKCH (90-120 mm) from Calumet River.

Ageing structures were placed in coin envelopes to dry and shipped to North/South Consultants in Winnipeg for age determination.

Table 2.6 Total number of ageing structures sampled from all length classes of fish collected from Horizon Lake, October 2018.

FTMN		LKCH		WHSC		LNSC		ARGR	
Length Class (mm)	n	Length Class (mm)	n	Length Class (mm)	n	Length Class (mm)	n	Length Class (mm)	n
0-30	0	0-30	0	0-50	0	0-70	0	200-250	4
31-40	10	31-50	1	51-90	4	71-110	0	251-300	3
41-50	11	51-60	2	91-130	12	111-150	0	301-350	3
51-60	10	61-80	7	131-170	5	151-190	2	-	-
61-70	12	81-100	11	171-210	4	191-230	0	-	-
71+	10	100+	10	211-250	11	231-270	0	-	-
-	-	-	-	251-300	4	271-320	0	-	-
-	-	-	-	301-350	2	321-370	0	-	-
-	-	-	-	351+	1	371+	0	-	-
Total	**53**	**Total**	**31**	**Total**	**43**	**Total**	**2**		**10**

2.1.5.4 eDNA Sampling (Stantec 2019)

Canadian Natural retained Stantec to complete an environmental DNA (eDNA) sampling program with a focus on detecting the presence of ARGR and BURB within the upper Tar River and Horizon Lake. The full Stantec report is provided in Appendix A6, with methods summarized below.

Sampling sites in the Tar River and Horizon Lake were selected from areas where Arctic grayling and burbot were expected to occur based on preferred habitat at the time of sampling, locations where the species have been historically captured, or where Arctic grayling were captured during the fall fishing program. Two sites were selected in the Tar River, upstream and downstream of the constructed habitat (rock weir), and six sites within Horizon Lake. Within the lake, three samples were collected from the pelagic zone (>2.5 m water depth) and three samples were collected from the littoral zone (<2.5 m water depth).

Water samples from Tar River and Horizon Lake were collected on October 5 and 6, 2019. Water grab samples were also collected from three sites within Horizon Lake and submitted to Maxxam Analytics for analysis of dissolved organic carbon (DOC) and total suspended solids (TSS) and one water sample from the deepest section of Horizon Lake was analyzed for tannins and lignins.

Prior to eDNA sampling, field equipment (e.g., Kemmerer sampler and buckets) was decontaminated with a 10% bleach solution and triple-rinsed with water from the first site sampled (Tar-1). When collecting a sample, field personnel wore clean nitrile gloves, all containers were pre-cleaned with 10% bleach solution, re-cleaned with a 10% bleach solution between sites, and then triple-rinsed with water from the next site. The samples were placed in high-density polyethylene (HDPE) plastic containers which were labeled with

the site identification, collection date, and time. The eDNA samples were kept cold until filtration. Each Horizon Lake eDNA sample was a composite 6 litre (L) sample made from three – 2 L subsamples collected using a Kemmerer sampler. Pelagic zone subsamples were collected approximately 1 m from the bottom, mid water column, and 1 m below the lake surface. Littoral zone subsamples were collected 1 m below the surface or mid water column as appropriate. Tar River samples were single 4 L samples collected at one site.

Arctic grayling caught during the concurrent Horizon Lake fish survey were held in two separate pails of lake water. The water from each pail (after fish were relocated) was used for the two positive control samples, including a duplicate from one pail. Deionized water was used as the negative control sample (absence of fish eDNA).

The samples were filtered in a clean facility (Horizon Mine on-site environmental lab) within 24 hours of sample collection to reduce the potential for eDNA degradation. To prevent cross-contamination between samples, clean disposable nitrile gloves were used, and equipment was pre-cleaned prior to filtration. Samples were filtered through single-use sterile 47 mm, 5 µm nitrocellulose filters using an ANDeTM peristaltic pump. Following filtration, each filter was removed while wearing clean nitrile gloves and using sterilized single-use tweezers. Each filter was folded and placed in a pre-labeled sterile envelope, placed in a zip-loc bag with desiccant, and frozen at -20°C.

The filters were shipped over-night to Precision Biomonitoring Inc. (PBI) in Guelph, Ontario for eDNA analysis. Upon receipt, filters were confirmed to be intact; however, the filters had thawed during shipment (Thomas 2019, pers. comm).

2.2 ANALYTICAL APPROACH AND DATA ANALYSIS

2.2.1 Water Quality

2.2.1.1 Water Chemistry

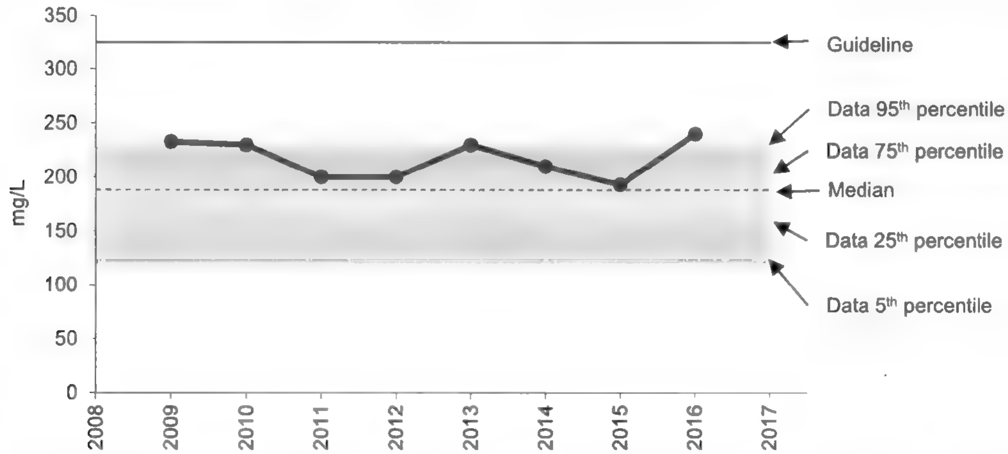
All water quality samples collected in 2018 were analyzed for the JOSMP standard set of variables (RAMP 2010); chlorophyll-*a* sampling and detailed nutrient analyses were also undertaken to assess lake trophic status. A complete list of water quality analytes is provided Table 2.2.

A total of 99 water quality variables were measured from Horizon Lake during the fall (September 2018) and winter (February 2019) sampling programs (Table 2.2). A subset of these variables was selected for detailed discussion in this report; these variables of interest are consistent with measurement endpoints used by JOSMP (JOSMP 2014), and include:

- pH — an indicator of acidity;
- Conductivity — a basic indicator of overall ion concentration;
- Total suspended solids (TSS) — a variable strongly associated with several other measured water quality variables, including total phosphorus, total aluminum, and numerous other metals;
- Dissolved phosphorous, total nitrogen, and nitrate+nitrite — indicators of nutrient status. Dissolved phosphorus rather than total phosphorus is included because it is the primary biologically-available species of phosphorus and because total phosphorus levels are strongly associated with TSS;
- Major ions (sodium, chloride, sulphate, calcium, and magnesium) — indicators of ion balance, which could be affected by discharges or seepages from oil sands development or by changes in the relative influence of groundwater;
- Total alkalinity — an indicator of the buffering capacity and acid sensitivity of waters;
- Total dissolved solids (TDS) and dissolved organic carbon (DOC) — indicators of total ion concentrations and dissolved organic matter (particularly humic acids), respectively;
- Total and dissolved aluminum — a variable of interest in some oil sands EIAs, by CEMA, and in the RAMP 5-year report. Total aluminum, for which water quality guidelines exist, has been demonstrated to be strongly associated with TSS. Dissolved aluminum more accurately represents biologically available forms of aluminum that may be toxic to aquatic organisms (Butcher 2001);
- Total boron, total molybdenum, and total strontium — three metals found in predominantly-dissolved form in waters of the Athabasca oil sands region (RAMP 2005), and may be indicators of groundwater influence in surface waters;
- Total arsenic and total mercury — metals of potential importance to the health of aquatic life and human health; and
- Naphthenic acids — relatively-labile hydrocarbons associated with oil sands deposits and processing that have been identified as a potential toxicity concern.

A selection of these analytes was graphed using Microsoft Excel® software to facilitate visual comparisons; the interpretation of these graphs is described in Figure 2.6. Additionally, regressions were conducted on each of these select analytes using the statistical program R (R Core Team 2018), to identify any significant temporal trends ($p < 0.05$). Water quality data typically exhibits seasonal fluctuations, so trend analysis was conducted independently for each season.

Figure 2.6 Example comparison of a water quality endpoint measured in Horizon Lake against the historical range of concentrations and relevant water quality guidelines.



All water quality results were compared against relevant guidelines for the protection of aquatic life, including Canadian Council of Ministers for the Environment (CCME 2014) and Alberta Surface Water Quality guidelines (Government of Alberta 2018). Discrete and near-continuous measurements of in situ water quality of Horizon Lake were presented in graphical form and summarized with descriptive statistics using Microsoft Excel®.

2.2.1.2 Trophic Status

Trophic status measures the degree of biological production within a lake. Trophic status of Horizon Lake was evaluated using the production-based trophic state index (TSI) presented in Wetzel (2001), where:

$$TSI = 14.42 \ln (\text{Total Phosphorus } [mg/m^3]) + 4.15$$

Total phosphorus concentrations were reported in mg/L concentrations, which were converted to mg/m^3 by multiplying the result by a factor of 1,000. In general, lakes with TSI values <40 are representative of oligotrophic conditions, 41-50 suggest mesotrophic conditions, 51-70 indicate eutrophic conditions, and values above 70 represent hypereutrophic conditions (Wetzel 2001).

Phosphorus (P) and nitrogen (N) are known to be the primary nutrients that influence the growth and biomass of primary productivity in freshwater ecosystems (Wetzel 2001). The molar ratio of total N to total P in water was used to estimate the relative supplies of N and P available to support algal growth in Horizon Lake. A molar N:P ratio below 20 is often indicative of N-limitations on algal growth, whereas P-deficient conditions are prevalent at molar N:P ratios greater than 50 (Guildford and Hecky 2000). At intermediate ratios (20-50), either of the two nutrients can be limiting.

2.2.1.3 Datalogger Strings

All available temperature (°C) and DO (mg/L) data from the 2018 and 2019 water-years (November 1 to October 31) were plotted into depth-integrated time-series graphs using Sigma Plot 12.5 software. The datalogger string was removed on September 6, 2017 for repairs and was not redeployed until December 21, 2017; therefore, there no data were available for the beginning of the 2018 water-year (November 1 to December 21, 2017). The period of record for the temperature and DO loggers extends from December 22, 2017 to February 22, 2019, which represents the last site visit conducted before this report was issued.

2.2.2 Sediment Quality

Lake sediments were collected during the September field program and analyzed for particle size, moisture content, carbon content, total metals, organics, and target and alkylated PAH (Table 2.7). Sample results were compared against CCME interim sediment quality guidelines (ISQG), which represent the concentration below which adverse biological effects to aquatic biota rarely occur, and probable effects levels (PEL), which represent the concentration that is expected to cause adverse effects to aquatic biota (CCME 2001, 2008).

2.2.2.1 Potential PAH Toxicity in Sediments

Estimation of potential PAH toxicity in Horizon Lake sediments was conducted using an approach adapted from Neff et al. (2005) and USEPA (2004), each of which apply a toxic units method to estimate the summed toxicity potential posed by the mixture of parent and alkylated PAH compounds present in a given sediment sample.

Briefly, the approach uses equilibrium partitioning (EqP; Di Toro et al. 1991; Di Toro and McGrath 2000) to estimate the sediment porewater (PW) concentration of individual compounds based on bulk sediment concentration, the organic-carbon-water partition coefficient (K_{oc}) of each compound, and the organic phase fraction (i.e., either TOC or petroleum hydrocarbon [PHC] non-aqueous phase liquid [NAPL]) present in the sediments, according to the following equations:

$$C_{PAH(pw)} = \left(\frac{C_{PAH(normalized)}}{K_{oc}}\right)$$

Where:

- $C_{PAH(pw)}$ is the estimated PAH concentration in sediment PW;
- $C_{PAH(normalized)}$ is the sediment PAH concentration normalized to the % organic phase in the sediments;
- K_{oc} is estimated from the following relationship: $\text{Log}(K_{oc}) = 0.00028 + 0.983 \times \log(K_{ow})$ (Di Toro and McGrath 2000);

And:

$$C_{PAH(normalized)} = \frac{C_{PAH(bulk)}}{\%\ organic\ phase}$$

Where:

- $C_{PAH(bulk)}$ is the bulk sediment PAH concentration;
- *% organic phase* is the proportion of TOC or PHC in the sediments, whichever is most appropriate for the calculation.

The underlying assumptions of the EqP method are that organic chemicals in sediments will partition primarily between the organic phase of the sediments and the sediment PW, and that this partitioning behaviour can be described accurately by the compound-specific K_{ow}. In addition, it is assumed that only the compounds present in sediment PW will be bioavailable to benthic organisms (i.e., available for uptake into organisms leading to a potential for a toxic effect). Validation of these assumptions is discussed in detail in Di Toro et al. (1999), Neff et al. (2005), and USEPA (2004).

The estimated $C_{PAH(pw)}$ for each individual compound is compared to its respective aqueous chronic toxicity value to estimate the hazard quotient (HQ) or toxic unit (TU) according to the following equation:

$$HQ = TU = \frac{C_{PAH(pw)}}{Chronic\ Toxicity\ Value}$$

Where

- *Chronic toxicity value* is determined using established models derived from experimental data.

The HQs are summed to produce a hazard index (HI) for total parent and alkylated PAH in sediment PW. Sediments exhibiting an HI greater than 1.0 have the potential to be toxic to aquatic biota (Neff et al. 2005), although it is important to consider that the PAH toxicity benchmark of 1.0 is intended to protect sensitive species against both acute and chronic toxic effects, and may not fully reflect tolerances of local organisms (USEPA 2004). It is also possible for sediments that are above the threshold of 1.0 to be non-toxic if there are site-specific partitioning conditions that reduce the bioavailability of these compounds (USEPA 2004).

It is expected that TOC, as opposed to PHC NAPL, would be the primary organic phase affecting the partitioning of PAHs in Horizon Lake sediments. For this reason, the USEPA (2004) approach to EqP, based on partitioning to TOC, was applied. The TOC determinations in Horizon Lake are based on a combustion method, which determines all organic carbon present in the sediments, and would therefore also account for the trace amounts of PHCs present.

Table 2.7 Physical, chemical, and biological variables measured in sediments collected from Horizon Lake, September 2018.

Group	Sediment Quality Variable		
Physical variables	Percent sand	Texture	Moisture content
	Percent silt	Percent clay	Soluble pH
Carbon content	Total organic carbon		
Total metals	Aluminum	Iron	Sodium
	Antimony	Lead	Strontium
	Arsenic	Lithium	Thallium
	Barium	Magnesium	Tin
	Beryllium	Manganese	Titanium
	Bismuth	Mercury	Tungsten
	Boron	Molybdenum	Uranium
	Cadmium	Nickel	Vanadium
	Calcium	Phosphorus	Zinc
	Chromium	Potassium	Zirconium
	Cobalt	Selenium	
	Copper	Silver	
Organics	CCME 4-fraction total hydrocarbons:	F1 (C6-C10) – BTEX	m & p-Xylene
	- F1 (C6-C10)	- Benzene	o-Xylene
	- F2 (C10-C16)	- Toluene	
	- F3 (C16-C34)	- Ethylbenzene	
	- F4 (C34-C50)	- Xylenes	
Target PAH	Acenaphthene	Benzo[ghi]perylene	Indeno(c,d-123)pyrene
	Acenaphthylene	Biphenyl	Naphthalene
	Anthracene	Chrysene	Perylene
	Benz[a]anthracene	Dibenzo[a,h]anthracene	Phenanthrene
	Benzo[a]pyrene	Dibenzothiophene	Pyrene
	Benzo[b]fluoranthene	Fluoranthene	Retene
	Benzo[e]pyrene	Fluorene	
Alkylated PAH	C1-Acenaphthenes	C2-Benzo[a]anthracenes/Chrysenes	C3-Fluoranthenes/Pyrenes
	C1-Benzo[a]anthracenes/Chrysenes	C2-Benzofluoranthenes/ Benzopyrenes	C3-Fluorenes
	C1-Benzofluoranthenes/ Benzopyrenes	C2-Biphenyls	C3-Naphthalenes
	C1-Biphenyls	C2-Dibenzothiophenes	C3-Phenanthrenes/Anthracenes
	C1-chrysene	C2-Fluoranthenes/Pyrenes	C4-Benzo[a]anthracenes/ Chrysenes
	C1-Dibenzothiophenes	C2-Fluorenes	C4-Dibenzothiophenes
	C1-Fluoranthenes/Pyrenes	C2-Naphthalenes	C4-fluoranthenes/pyrenes
	C1-Fluorenes	C2-Phenanthrenes/Anthracenes	C4-Naphthalenes
	C1-Naphthalenes	C3-Benzo[a]anthracenes/Chrysenes	C4-Phenanthrenes/Anthracenes
	C1-Phenanthrenes/Anthracenes	C3-Dibenzothiophenes	

Note: Any summations of total PAH did not include retene, as it is also accounted for in total C4-substituted phenanthrene/ anthracene.

2.2.3 Phytoplankton and Zooplankton

Phytoplankton and zooplankton field samples were analyzed at the Bio-Limno laboratory in Halifax, NS. Aliquots of the preserved phytoplankton samples were allowed to settle overnight in sedimentation chambers following the procedure of Lund et al. (1958). Counting units were individual cells, filaments, or colonies depending on the organization of the algae. The algal units were counted from three or more transects on an inverted microscope. A minimum of 400 units were counted for each sample. Taxonomic identifications were performed up to lowest practical taxonomic level (LPL) based primarily on Anton and Duthie (1981), Findlay and Kling (1979a,b), Prescott (1982), Whitford and Schumacher (1984), Starmach (1985), Krammer and Lange-Bertalot (1986, 1988, 1991a,b) and Komárek J, Hindák (1988).

Phytoplankton biomass (µg per m^3) was calculated from recorded abundance and specific biovolume estimates from geometric solids (Rott 1981), assuming unit specific gravity. The biovolume (mm^3 per m^3 fresh weight) of each taxon was estimated from the average dimensions of 10 to 15 individuals. The biovolumes of colonial taxa were based on the number of individuals in a colony. All calculations for cell concentration and biomass were performed with Hamilton's (1990) computer program.

Zooplankton samples were identified and enumerated from three 1 to 5 ml sub-samples using a dissecting microscope at magnifications of 12 to 50x for macro-zooplankton, and an inverted microscope at magnifications of 200 to 400x for rotifers and copepod nauplii. Sub-sample volumes depended primarily on the amount of particulate materials in the sample, and sub-samples for rotifers and nauplii were allowed to settle for a 24-hr period prior to counting. Zooplankton were identified using keys from Brooks (1957), Edmondson (1966), Chengalath (1971), Grothe and Grothe (1977), Pennak (1978), Stemberger (1979), Clifford (1991), and Thorp and Covich (1991).

Zooplankton biomass (µg per m^3) was calculated from published length-weight regressions (Bottrell et al. 1976; Downing and Rigler 1984). Lengths were determined directly using a microscope fitted with a micrometer in the ocular. In each subsample, a minimum of 10 individuals were measured for the dominant species and for fewer or less dominant species, measurements were taken as the species were encountered. The average of the measurements (lengths) from the three samples were used in the length-weight regressions. Total biomass for a species was calculated by multiplying the biomass of each species by the total density (number of individuals/m^3) of that particular species.

The following metrics describing phytoplankton and zooplankton communities were used to measure environmental quality in Horizon Lake:

- *Total Density*: the total number of individuals per unit volume of water. Nutrient enriched systems often support a greater abundance of plankton communities;
- *Total Biomass:* The total weight of organisms per unit volume of water (µg per m^3);
- *Community Composition*: The percentage that each major taxonomic group contributes to the overall abundance and biomass;
- *Taxonomic Richness*: Indicates the number of distinct taxa present in a sample, calculated based on the LPL. Systems with more taxa are generally considered to be of higher environmental quality. Moderate nutrient enrichment generally increases the number of taxa, while excessive enrichment may affect water oxygenation, resulting in a reduction in richness. Toxic conditions in water or sediment will also reduce taxa richness;

- *Simpson's Diversity Index*: One of several measures of "diversity" that incorporates both the number of species (richness) and the relative abundance of the different taxa (evenness) in a sample (Simpson 1949). Simpson's diversity index (*D*) takes into account both the abundance patterns and taxonomic richness of the community. This is calculated by determining, for each taxonomic group at a site, the proportion of individuals that it contributes to the total at the site. This diversity index can range from 0 to 1, with a value of 1 representing the highest diversity. Simpson's diversity index is calculated as:

$$D = 1 - \sum_{i=1}^{s} [p_i]^2$$

Where:

D = Simpson's index of diversity;

S = the total number of taxa (family) at the site; and

p_i = the proportion of the *i*th taxon at the site.

- *Evenness*: Evenness takes into consideration the relative abundance of each taxon in proportion the taxonomic richness at the site. Evenness ranges from 0 to 1, where an evenness of 1 represents a community where each taxon present is equally abundant and an evenness approaching 0 represents a community where taxa differ widely in abundance. A community dominated by only a few species is considered to be less diverse than one with several different species with similar abundance (Smith and Wilson 1996).

Evenness is calculated as:

$$E = 1 / \sum_{i=1}^{s} [p_i]^2 / S$$

Where:

E = Evenness;

p_i = the proportion of the *i*th taxon (family) at the site; and

S = the total number of taxa at the site.

- Additionally, chlorophyll *a* concentration was measured during each sampling event; chlorophyll *a* results are tabulated in the water quality section of this report.

2.2.4 Benthic Invertebrates

Major-taxa-level taxonomic data were used to assess benthic invertebrate community structure in Horizon Lake. Certain taxa (*Cladocera, Copepoda, Ostracoda, Nemata*, and non-aquatic taxa) were removed from analyses because these taxa can bias a sample (i.e., they are not adequately sampled using a 400 µm kicknet, are not generally benthic, can be present in extremely high numbers, or are terrestrial). These methods follow the procedures outlined in the CABIN protocol (Environment Canada 2014).

Metrics used to evaluate benthic invertebrate community structure were similar to the plankton analyses, and included: total abundance, total biomass, community composition, taxonomic richness, Simpson's diversity, and evenness (see Section 2.2.2 for further details). In addition, percent *ETO* (percentage of fauna as *Ephemeroptera, Trichoptera,* and *Odonata*) was calculated, which is a measure of all benthic invertebrates in a sample that belong to the more sensitive groups of mayflies, caddisflies, and dragonflies / damselflies. This measure is generally more applicable to lake habitats than the measure of EPT (*Ephemeroptera, Plecoptera,* and *Trichoptera*) that is used for erosional stream habitats, given *Plecoptera* are more commonly found in riverine environments and *Odonata* are more common in lake habitats (Merritt, Cummins, and Berg 2008). Averages (n = 15 replicate samples per depth stratum) were calculated for the mid-lake, littoral, and near-shore zones of Horizon Lake. Richness per depth stratum (near-shore, littoral, and mid-lake) was analyzed as average richness (n = 15 replicates per depth stratum) and pooled richness (n = 15 replicates per depth stratum); average species richness was calculated by averaging the species richness observed across all replicates within a depth stratum, whereas pooled richness represents the total number of different taxa observed in each of the three strata.

Regression analyses were performed on average benthic invertebrate density, species richness, Simpson's diversity, and evenness for each depth strata (mid-lake, littoral, and near-shore) to assess for the presence of temporal trends (2008 to 2018). Regression analysis could not be completed for density at the near-shore sites because this was only the second year that density could be calculated, following the transition from kick-netting to grab sampling in 2017.

Functional feeding groups were classified according to guidelines outlined by the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT 2003). Functional feeding groups represent modes of food acquisition based on an individual's principal feeding mechanism and were used to classify taxonomic groups present in the benthic invertebrate community at the trophic level. Functional feeding groups were considered not available (N/A) if the functional feeding group for an organism was not classified by SAFIT or if an organism could not be identified to the genus level.

2.2.5 Fish

2.2.5.1 Tar River Spring Spawning Migration

The spring migration monitoring program is undertaken to address three primary objectives:

- Quantify the number of fish species that utilize the section of the Tar River directly upstream of Horizon Lake during the spring spawning migration;
- Document fish movements in and out of Horizon Lake to better understand seasonal habitat use, including how Tar River contributes to the sustainability of fish populations in the lake; and
- Monitor fish growth and fish movements through the insertion and recapture of PIT tags.

The following conventional measurement endpoints of fish communities were calculated from the fish abundance data collected from each study site using each fishing method:

- *Species richness*: The total number of species present in a specified area; and
- *Catch-per-unit-effort (CPUE)*: The total number of fish captured per unit of effort, which allows shifts in species dominance to be tracked over time.

PIT Tag Antenna

There are currently three years (2016 to 2018) of concurrent lower and upper PIT tag antennae data (Figure 2.7). Data from the antennae were used to determine how the Tar River supports fish populations in Horizon Lake by assessing:

1. Tag returns over time – quantify the numbers and species of fish that utilize the section of the Tar River directly upstream of Horizon Lake;
2. Timing of movements – assess movements in and out of the lake to better understand seasonal habitat use;
3. Upper Tar River residence time – determine how long individual fish are residing in the Tar River; and
4. Movements in relation to water temperature and flow – provide information on migration timing and environmental triggers for these movements.

The 2018 PIT data contained records for all 7 antennae (#1 through #4 in the downstream array, and #5 to #7 in the upstream array). 31,157 tag responses were recorded: 59 records of ARGR tags, 30,057 records of LNSC tags, 932 records of WHSC tags, and 109 records of unknown tags. This list of tag responses includes tags recorded at multiple antennae at the same time, as well as consecutive records of a fish "sitting" near an antenna. The first record of 2018 occurred on March 3 at 18:02; the last tag was recorded on September 15 at 23:37.

Compilation of the PIT records and associated analysis was completed using scripts written in R[1]. Data were imported directly into R and processed to create working versions of the data for analysis and reporting. Bi-Hex formatted tags were converted to decimal (DEC) format by splitting the country/manufacturer code (i.e., the first three bytes in the Bi-Hex tag), converting both sections of the tag, and then recombining into a fifteen-digit number. All data were handled and stored as serial data objects.

[1] www.r-project.org

2.2.5.2 Fish Health

Annual fish condition was used to assess for changes in energy storage in ARGR, WHSC, LNSC, FTMN, and LKCH captured in Horizon Lake. The following analyses were performed to evaluate fish condition:

- Fulton's Condition Factor was calculated as K = (body weight/fork length^3) x100, where weight is in grams and length is in centimeters. Condition factor was used for tabular and graphical presentations showing mean annual condition for each species; and

- Normality of length and weight data was tested on untransformed and log-transformed data using the Lilliefor's option of the Kolmogorov-Smirnov test; assumptions of normality were not met so an analysis of covariance (ANCOVA) could not be completed to compare fish condition among years (2009 to 2018).

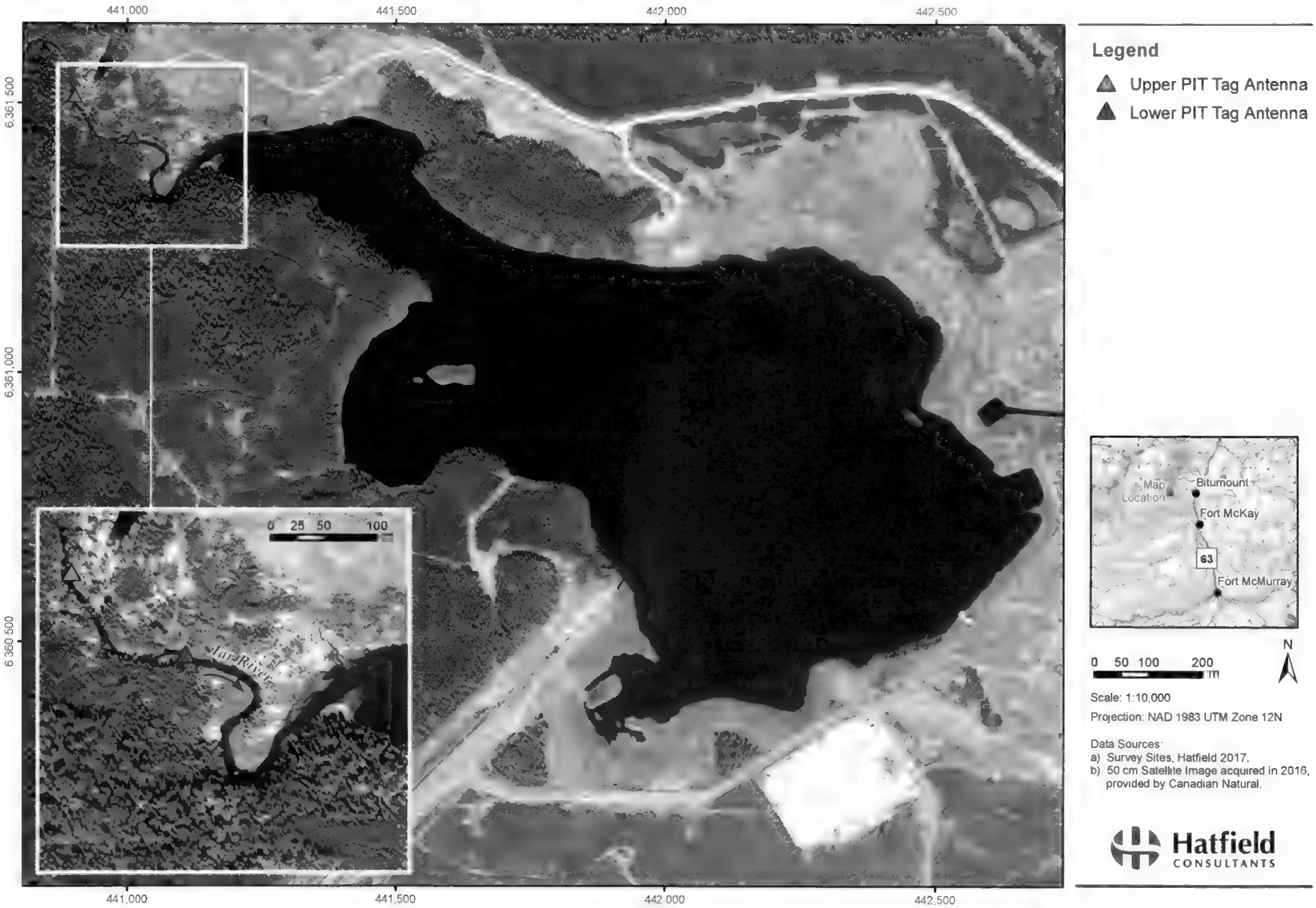
Concentrations of total mercury, methyl mercury, total metals, and organic compounds were measured in FTMN (60-70 mm), LKCH (90-120 mm), and juvenile WHSC (80-100 mm) collected from Horizon Lake and the Calumet River Watershed, to assess tissue loadings (contaminant accumulations) in the context of human consumption as well as to provide additional support in characterizing fish health. A full list of fish tissue analytes is provided in Table 2.8.

Health Canada guidelines for mercury in fish tissue are available for total mercury, which makes a conservative assumption that 100% of total mercury in edible fish tissue is present as methyl mercury (reviewed in Health Canada 2007b).

Fish tissue data were compared between Horizon Lake and the Calumet River watershed, and both datasets were screened against guidelines to assess potential risk to human health (Table 2.9) and fish health (Table 2.10). The risk of adverse effects to fish health from contaminant accumulation was assessed according to the concentrations of metals that have lethal, sub-lethal, or no effects on freshwater fish (Table 2.10; derived from laboratory studies summarized in Jarvinen and Ankley 1999). These parameters and criteria were sourced from the JOSMP fish tissue program (JOSMP 2015).

Temporal trends of total and methyl mercury concentrations in WHSC captured from Horizon Lake during fall sampling (2009 to 2018) were assessed graphically using length-normalized (to the mean length of captured fish) mercury concentrations. Bartlett's test was used to evaluate homogeneity of variances, and the Lilliefor's option of the Kolmogorov-Smirnov test was used to examine deviations from normality to test assumptions of ANCOVAs. These tests were run separately for length and mercury concentrations. If an endpoint exhibited significant heterogeneity of variances or deviations from normality, the data for that endpoint were log-transformed and the tests were re-run. All data met assumptions of normality and homogeneity of variances; however, ANCOVA can only proceed if the dependent variable is linearly related to the covariate. Regression analyses identified significant interaction terms ($p < 0.05$) for total and methyl mercury, so ANCOVAs could not be run.

Figure 2.7 Location of the PIT Tag antennae on the Tar River.



Horizon Lake Monitoring Program 2018

K:\Data\Project\CNRL9078\A_MXD\2018_Technical_Report\CNRL9078_Fig2_10_Location_PitTag_Antennae_TarRiver_20190430_v_1_SS.mxd

Table 2.8 Analytes measured in fish tissue samples collected from Horizon Lake and the Calumet watershed, October 2018.

	Total Metals	
Aluminum (Al)	Iron (Fe)	Silver (Ag)
Antimony (Sb)	Lead (Pb)	Sodium (Na)
Arsenic (As)	Lithium (Li)	Strontium (Sr)
Barium (Ba)	Magnesium (Mg)	Tellurium (Te)
Beryllium (Be)	Manganese (Mn)	Thallium (Tl)
Bismuth (Bi)	Mercury (Hg)	Thorium (Th)
Boron (B)	Methyl Mercury (CH_3Hg^+)	Tin (Sn)
Cadmium (Cd)	Molybdenum (Mo)	Titanium (Ti)
Calcium (Ca)	Nickel (Ni)	Uranium (U)
Cesium (Cs)	Phosphorus (P)	Vanadium (V)
Chromium (Cr)	Potassium (K)	Zinc (Zn)
Cobalt (Co)	Rubidium (Rb)	Zirconium (Zr)
Copper (Cu)	Selenium (Se)	
	Organics	
1,1,1,2-Tetrachloroethane	2,2-Dichloropropane	Hexachlorobutadiene
1,1,1-Trichloroethane	2-Chlorotoluene	Isopropylbenzene
1,1,2,2-Tetrachloroethane	4-Chlorotoluene	m+p-Xylenes
1,1,2-Trichloroethane	Benzene	Methylene chloride
1,1-Dichloroethane	Bromobenzene	n-Butylbenzene
1,1-Dichloroethene	Bromochloromethane	n-Propylbenzene
1,1-Dichloropropene	Bromodichloromethane	o-Xylene
1,2,3-Trichlorobenzene	Bromoform	p-Isopropyltoluene
1,2,3-Trichloropropane	Bromomethane	sec-Butylbenzene
1,2,4-Trichlorobenzene	Carbon tetrachloride	Styrene
1,2,4-Trimethylbenzene	Chlorobenzene	tert-Butylbenzene
1,2-Dibromo-3-chloropropane	Chloroethane	Tetrachloroethene
1,2-Dibromoethane	Chloroform	Toluene
1,2-Dichlorobenzene	Chloromethane	trans-1,2-Dichloroethene
1,2-Dichloroethane	cis-1,2-Dichloroethene	trans-1,3-Dichloropropene
1,2-Dichloropropane	cis-1,3-Dichloropropene	Trichloroethene
1,3,5-Trimethylbenzene	Dibromochloromethane	Trichlorofluoromethane
1,3-Dichlorobenzene	Dibromomethane	Vinyl chloride
1,3-Dichloropropane	Dichlorodifluoromethane	Thiophene
1,4-Dichlorobenzene	Ethylbenzene	

Table 2.9 Standards used for evaluating potential human health risks of fish consumption.

Measurement Endpoint[1]	Units	Health Canada		National USEPA[4]		Region III USEPA[5]
		General[2]	Subsistence[3]	Recreational	Subsistence	Risk-based Criteria
Total Metals						
Aluminum (Al)	mg/kg	nc	nc	nc	nc	1,500
Antimony (Sb)	mg/kg	nc	nc	nc	nc	0.62
Arsenic (As)[6]	mg/kg	nc	nc	0.026	0.00387	0.0028
Barium (Ba)	mg/kg	nc	nc	nc	nc	310
Beryllium (Be)	mg/kg	nc	nc	nc	nc	3.1
Bismuth (Bi)	mg/kg	nc	nc	nc	nc	nc
Cadmium (Cd)	mg/kg	nc	nc	4.0	0.491	1.5
Calcium (Ca)	mg/kg	nc	nc	nc	nc	nc
Chromium (Cr)	mg/kg	nc	nc	nc	nc	0.0083
Cobalt (Co)	mg/kg	nc	nc	nc	nc	0.46
Copper (Cu)	mg/kg	nc	nc	nc	nc	62
Iron (Fe)	mg/kg	nc	nc	nc	nc	1,100
Lithium (Li)	mg/kg	nc	nc	nc	nc	3.1
Magnesium (Mg)	mg/kg	nc	nc	nc	nc	nc
Manganese (Mn)	mg/kg	nc	nc	nc	nc	220
Mercury (Hg)[7]	mg/kg	0.5, 1[8]	0.2	0.4	0.058	0.15
Molybdenum (Mo)	mg/kg	nc	nc	nc	nc	7.7
Nickel (Ni)	mg/kg	nc	nc	nc	nc	31
Phosphorus (P)	mg/kg	nc	nc	nc	nc	nc
Potassium (K)	mg/kg	nc	nc	nc	nc	nc
Selenium (Se)	mg/kg	nc	nc	20	2.457	7.7
Silver (Ag)	mg/kg	nc	nc	nc	nc	7.7
Sodium (Na)	mg/kg	nc	nc	nc	nc	nc
Strontium (Sr)	mg/kg	nc	nc	nc	nc	930
Thallium (Tl)	mg/kg	nc	nc	nc	nc	0.015
Tin (Sn)	mg/kg	nc	nc	nc	nc	930
Titanium (Ti)	mg/kg	nc	nc	nc	nc	nc
Vanadium (V)	mg/kg	nc	nc	nc	nc	7.8
Zinc (Zn)	mg/kg	nc	nc	nc	nc	460
Tainting Compounds						
1,3,5-trimethylbenzene	mg/kg	nc	nc	nc	nc	15
2-Methylthiophene	mg/kg	nc	nc	nc	nc	nc
Toluene	mg/kg	nc	nc	nc	nc	120
Thiophene	mg/kg	nc	nc	nc	nc	nc
m+p-xylene	mg/kg	nc	nc	nc	nc	310

1 Measurement endpoints listed are for variables that have a human health criterion under Health Canada or National USEPA.
2 Health Canada (2018). Available at: http://www.hc-sc.gc.ca/fn-an/securit/chem-chim/contaminants-guidelines-directives_e.html
3 Health and Welfare Canada (1979).
4 USEPA (2000). Available at: https://www.epa.gov/fish-tech/epa-guidance-developing-fish-advisories
5 USEPA (2018). Available at: https://www.epa.gov/risk/regional-fish-regional-screening-levels-rsls-may-2018. Note: where concentrations for carcinogenic target risk and noncancer hazard index were available, the most conservative value was used.
6 Criteria are for inorganic arsenic. Total arsenic data were converted to inorganic arsenic based on ATSDR (2009).
7 Criteria are for total mercury and methyl mercury, assuming equivalence.
8 Species dependent.
nc – no criterion

Table 2.10 Summary of criteria used for evaluating potential risk to fish health based on concentrations of metals that have lethal, sublethal, and no effects on freshwater fish.

Variable	Endpoint		Concentrations (mg/kg)	Tissue	Tested Species	Life Stage or Size	Route	(Days)
Metals								
Aluminum	Survival	no effects	1.0 - 1.15	muscle	rainbow trout, Atlantic salmon	171 g, alevin	oral, water	30 - 42
		effects	20 - 36.8	whole body	Atlantic salmon	alevin	water	30
Antimony	Survival	no effects	5	whole body	rainbow trout	fingerling (1.2 g)	water	30
		effects	9	whole body	rainbow trout	fingerling (1.2 g)	water	30
Arsenic	Survival	no effects	2.6 - 11.4	carcass, whole body	rainbow trout	juvenile	oral, water	21 - 56
		effects	11.2 - 17.9	carcass	rainbow trout	juvenile	oral	56
	Growth	no effects	0.9 - 6.5	carcass, whole body	rainbow trout	juvenile	oral, water	21 - 56
		effects	3.1	carcass	rainbow trout	juvenile	oral	56
Cadmium	Survival	no effects	0.02 - 2.8	muscle	rainbow trout, brook trout	150 -200 g, adult	water, ip injection[1]	210 - 455
		effects	0.14 - 0.7	whole body	rainbow trout, brook trout	5 - 15 g	water	29 - 30
	Growth	no effects	0.09 - 2.8	muscle, whole body	rainbow trout, brook trout	3.1 g, 5 g, adult	water	30 - 455
		effects	0.12 - 0.96	muscle, whole body	rainbow trout, Atlantic salmon	3.1 g, alevin	water	92 - 210
	Reproduction	no effects	0.4	muscle	rainbow trout	adult	water	455
		effects	0.6	muscle	rainbow trout	adult	water	455
Copper	Survival	no effects	0.5 - 3.4	muscle	rainbow trout, brook trout	embryo-adult-juvenile	water	0.33 - 720
		effects	0.5	muscle	rainbow trout	138 g	water	0.33
	Growth	no effects	3.4	muscle	brook trout	embryo-adult-juvenile	water	720
	Reproduction	no effects	3.4	muscle	brook trout	embryo-adult-juvenile	water	720
Lead	Survival	no effects	4.0	carcass	rainbow trout	under-yearlings (6.5 g)	water	224

Source: JOSMP 2015

- = no data; 1 ip injection = intraperitoneal injection is the injection of a substance into the body cavity; 2 methylated forms of mercury.

Only thresholds derived from the most relevant studies were used to screen the fish tissue data; those derived from studies on small-bodied fish or tropical fish species, and those that simultaneously evaluated effects of conventional variables on toxicity or maternal transfer studies, were excluded. Effects concentrations associated with acute exposures were only included for contaminants where few other data existed.

Table 2.10 (Cont'd.)

Variable	Endpoint		Concentrations (mg/kg)	Tissue	Tested Species	Life Stage or Size	Route	(Days)
Mercury[2]	Survival	no effects	1.91 - 35.0	whole body, muscle	rainbow trout, brook trout	10 - 20 mm, juvenile, fingerling, yearling-adult, adult	ip injection[1], oral, water	15 - 273
		effects	3.7 - 31	whole body, muscle	rainbow trout, brook trout	10 - 20 mm, subadult (100 - 150 g)	ip injection[1], oral	186 - 273
	Growth	no effects	2.28 - 29.0	whole body, muscle	rainbow trout	fingerling, juvenile	oral, water	24 - 105
		effects	8.6 - 35.0	whole body, muscle	rainbow trout	fingerling	oral	84 - 105
	Reproduction	no effects	9.2	muscle	brook trout	yearling-adult	water	273
		effects	23.5	muscle	brook trout	yearling-adult	water	273
Nickel	Survival	no effects	0.82 - 58.0	muscle	rainbow trout, carp	15 g, 150 - 200 g	water	5 - 180
		effects	118.1	muscle	Carp	15 g	water	4
Selenium	Survival	no effects	0.28 - 3.1	whole body, carcass	rainbow trout, chinook salmon	larvae-swim-up, egg-juvenile,	water, oral	28 - 308
					largemouth bass	fingerling-juvenile, juvenile		
		effects	0.92 - 2.5	whole body, carcass	rainbow trout, chinook salmon	larvae-swim-up, fingerling-juvenile	water, oral	28 - 168
	Growth	no effects	0.08 - 1.08	whole body, carcass	rainbow trout, chinook salmon	larvae-swim-up, egg-juvenile	oral	60 - 308
		effects	0.32 - 2.08	whole body, carcass	rainbow trout, chinook salmon	larvae-swim-up, fingerling-juvenile, juvenile	oral	60 -168
Silver	Survival	no effects	0.003	carcass	largemouth bass	young-of-year	water	180
	Growth	no effects	0.003	carcass	largemouth bass	young-of-year	water	180
Vanadium	Survival	no effects	5.33	carcass	rainbow trout	juvenile	oral	84
	Growth	no effects	0.02	carcass	rainbow trout	juvenile	oral	84
		effects	0.41	carcass	rainbow trout	juvenile	oral	84
Zinc	Survival	no effects	60	whole body	Atlantic salmon	juvenile	water	80
	Growth	no effects	60	whole body	Atlantic salmon	juvenile	water	80

Source: JOSMP 2015

- = no data; 1 ip injection = intraperitoneal injection is the injection of a substance into the body cavity; 2 methylated forms of mercury.

Only thresholds derived from the most relevant studies were used to screen the fish tissue data; those derived from studies on small-bodied fish or tropical fish species, and those that simultaneously evaluated effects of conventional variables on toxicity or maternal transfer studies, were excluded. Effects concentrations associated with acute exposures were only included for contaminants where few other data existed.

2.2.5.3 Fish Production Estimates

Abundance Estimates

Fish population abundance estimates were calculated using hydroacoustic survey data collected in October 2018. To allow for comparison, data collection and analyses followed similar approaches to previous years (see Golder 2013a, 2014, 2015 and Hatfield 2016, 2017, 2018 for details on previous analytical techniques).

Hydroacoustic Survey

Echoview software (v 9) was used to process the hydroacoustic fish density data. A full description of population estimate calculations is provided in Appendix A5. Total population abundance was calculated for each survey (night 1 and night 2) using a weighted estimated that corrected for unequal survey interval lengths (Appendix A5).

Species-Specific Abundance Estimates

Species composition estimates from the October fish sampling program were applied to fish density estimates from the hydroacoustic survey to generate species-specific abundance estimates. The fish sampling program was run concurrently with the hydroacoustic study to verify fish population structure and species composition. Volumetric candidate fish track density (fish/m^3) was calculated for each 100 m horizontal distance interval and for three depth intervals (<2 m, 2-4 m and >4 m). Volumetric density was then multiplied by the mean interval depth to calculate the areal density (fish/m^2). The calculated areal density was then multiplied by the surface area that the interval was extrapolated out to; 5 m on each side of the interval, for a total of 10 m. This calculation resulted in the fish population estimate for that interval. The total fish area population estimate was calculated by adding together the individual interval population estimates in the survey area. Since some of the intervals were less than 100 meters in length, the individual interval volumes were weighted by what percentage each interval sample volume was, based on the mean interval sample volume. A lake-wide species-specific abundance estimate was then calculated.

Biomass and Production

All analyses were run using R statistical software (R Development Core Team 2013).

Abundance-At-Age

Percent abundance-at-age estimates for ARGR, WHSC, LNSC, FTMN, and LKCH were generated from age-at-length keys, which used the ageing data collected during the fish sampling program. Age-at-length keys are often used to determine the age structure of a population from a subsample of fish ages and lengths, by producing a probability matrix of the proportion of individuals within a given length-class having a certain age (Ogle 2015; Guy and Brown 2007).

Abundance-at-age was determined by applying the percent abundance-at-age to the total abundance for each species. The abundance-at-age for each species was calculated as:

$$N_{\alpha} = N \times u_{\alpha}$$

Where N_a is abundance-at-age *a*, *N* is total species-specific abundance, and u_a is the proportion of aged individuals in class *a*. The age-at-length key for ARGR was calculated using all aged fish captured in 2015, 2016, 2017, and 2018 because an insufficient number of ARGR observations were available for 2018. The age-length key for LNSC was determined from the 2017 fish capture program because only 2 LNSC were captured during the 2018 fish capture program.

Biomass-At-Age

Abundance-at-age data were used to fit a Von Bertalanffy growth model to generate length-at-age relationships for each species. Growth curves were produced by fitting ages and corresponding lengths to a von Bertalanffy growth curve using the equation:

$$l_a = L\infty(1 - e^{-K(a-a_0)})$$

where l_a is length-at-age a, $L\infty$ is the asymptotic length at which growth rate is zero, *K* is a growth rate parameter, and a_0 is the age at which length would be zero. Length-at-age generated from the von Bertalanffy growth curves was then used to estimate average weight-at-age using the relationship between weight and length (see Appendix A7). Weight-at-age and abundance-at-age were used to calculate biomass using the following formula:

$$B_a = w_a * N_a$$

where B_a is the biomass at age a, w_a is the weight-at-age, and N_a is the abundance-at-age.

The growth modeling and the weight-at-age modeling for fathead minnows used a linear growth model based on the equation:

$$l_a = a_0 + k \times a$$

where l_a is length-at-age a, and a_0 is the length at age-0. The linear growth model was necessary because the non-linear model fitting algorithm could not converge for the von Bertalanffy model. The linear model was considered suitable because range of ages covered all ages in the age-length key.

Error from parameter estimation was carried throughout the model using bootstrapping methods. Random values were selected at each stage of the process to generate a distribution of final outputs that were used to calculate confidence intervals. Simulations were run 500 times to generate distributions.

Instantaneous Growth Rate

The instantaneous growth rate was calculated at each age using:

$$G_a = \ln(w_{a+1}) - \ln(w_a)$$

where G_a is the instantaneous growth rate from age a to age $a + 1$. The oldest age class of all fish were assumed to survive to the following year and were included. The linear regression of log (G_a) on age was used to estimate the instantaneous growth rate for the oldest age class.

Production

Instantaneous growth-rate-at-age and biomass-at-age were used to estimate production for each species as:

$$P = \sum_{a=0}^{n} G_a B_a$$

where a is age in years and n is the maximum age.

Production of ARGR, WHSC, LNSC, FTMN, and LKCH was summed to generate a total production estimate for the lake. Error from parameter estimation was carried throughout the model using parametric bootstrapping methods. Random values were selected at each stage of the process to generate a distribution of final outputs that were used to calculate confidence intervals. Simulations were run 500 times to generate distributions.

2.2.5.4 eDNA Sampling (Stantec 2019)

The eDNA sampling methods used for the Horizon Lake and Tar River assessment were based on eDNA sampling protocols from British Columbia (Hobbs et al. 2017) and United States Geological Survey (Matthew et al. 2012). Sampling was conducted by a Stantec scientist trained in eDNA sampling design and field methods, assisted by a Canadian Natural representative.

PBI's analytical procedures follow a quality assurance and quality control plan that prevents cross-contamination of samples during analysis and verifies that quality control steps are in place for each step of sample analysis. PBI's analyses are verified by a third-party lab accredited by the International Organization for Standardization (ISO/IEC 17025) (Thomas 2019, pers. comm.). Additional details on the analyses are provided in Stantec 2019 (Appendix A6).

2.2.6 Quality Assurance and Quality Control

A variety of quality control procedures were applied during the 2018 Program, with the objective of providing incremental checks and balances throughout data collection, data analysis, and reporting. Detailed descriptions of the QA/QC procedures and results specific to each sampling task are provided in Appendix A8.

3.0 RESULTS AND DISCUSSION

3.1 WATER QUALITY

3.1.1 *In Situ* Water Quality

Continuous water temperature data from the thermistor strings deployed in Horizon Lake documented spring turnover in mid-May (Figure 3.1); a thermocline was established in late May and persisted until mid-September. Seasonal surface water temperatures were near or below the minimum historical observations in 2018 (Figure 3.2), while average daily temperature at the one-meter depth interval peaked at 22.8 °C on June 24.

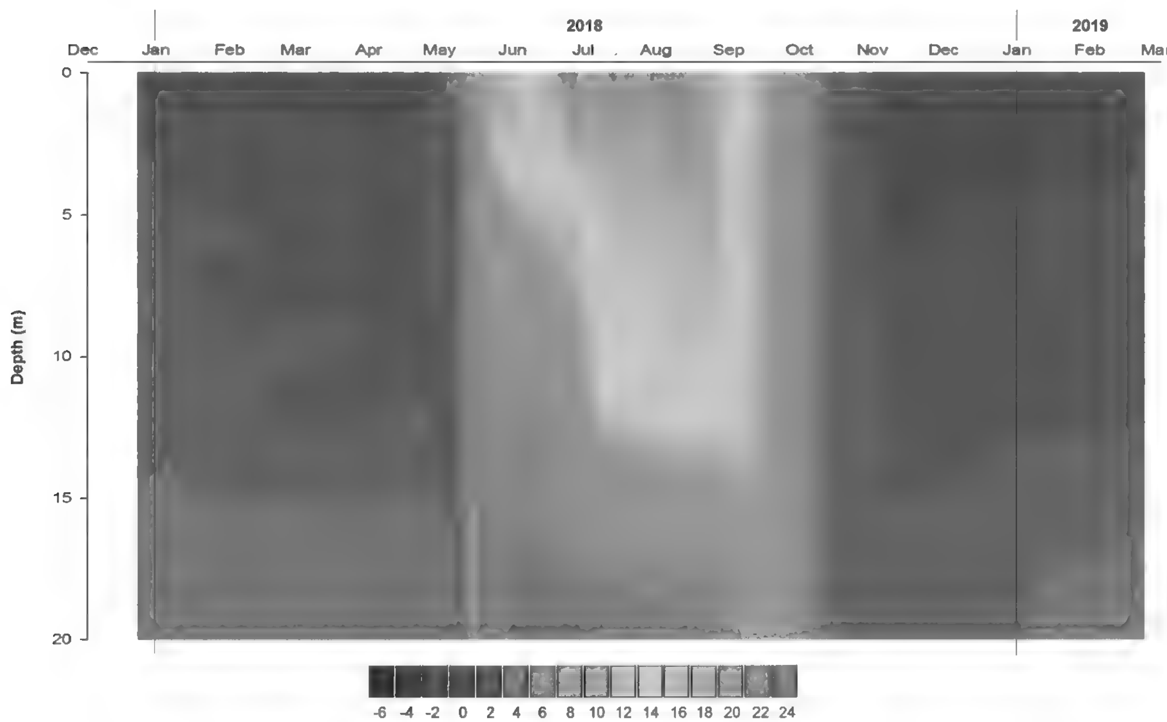
Near-continuous DO concentrations showed a general decline at the 5 m and 10 m depth intervals from January until April; data were not available from early April through early June because the DO membranes on the loggers had expired, but it is expected that DO increased in mid-May in response to spring turnover, similar to patterns observed in previous years (Figure 3.3). DO declined over the summer, reaching an annual minimum of 2.2 mg/L at 5 m in mid-August and 0.6 mg/L at 10 m in late August, following by an increase in response to fall turnover that continued through October (Figure 3.3). The seasonal DO patterns observed in 2018 were similar to all previous years of monitoring (2013, 2015, 2016, and 2017; Figure 3.3).

The discrete DO profiles also identified a decline in pelagic zone DO, with concentrations falling below 5.5 mg/L in the bottom 4 to 6 m of the water column in all months except October (Figure 3.2). DO concentrations less than 5.5 mg/L are below the lowest acceptable concentration to support all life-stages of all species of fish (CCME 1999a); however, according to the published habitat suitability model for WHSC (Twomey 1984), adults and juveniles have a high tolerance for hypoxic conditions, with sublethal effects on fry only observed at DO levels <2.5 mg/L (Siefert and Spoor 1974). Juvenile WHSC were also observed to tolerate DO concentrations down to 0.98 mg/L at 2°C (Smale and Rabeni 1995), demonstrating that WHSC are capable of surviving periods of low DO, particularly during colder winter months. ARGR are also known to tolerate low levels of DO and have been observed in overwintering areas with concentrations ranging from 4.8 down to 0.6 mg/L (reviewed in Hubert et al 1985). The habitat suitability index for ARGR suggests DO levels ≥ 2 mg/L are suitable during summer and late winter in lacustrine habitats (Golder 2008). Many forage fish species are also capable of tolerating low DO conditions; there are no published riverine or lacustrine habitat evaluation procedures for LKCH or FTMN, but the regional habitat suitability models for the oil sands consider late winter DO concentrations above 1 mg/L to provide above average conditions for both LKCH and FTMN (Golder 2008). DO profiles identified a decline in profundal DO between July and September, with near-bottom DO concentrations decreasing to below 1 mg/L at depths >14 m in July and September 2018 and February 2019; however, there was abundant access to well-oxygenated water in the lake at this time, and fish would be expected to simply avoid the low oxygen areas until turnover replenished the oxygen supply.

In situ pH ranged from 6.78 to 8.45 in 2018/2019 and remained within water quality guidelines for the protection of aquatic life (6.5 – 9.0; CCME 2014) at all depths (Figure 3.4). All pH profiles collected during the spring and fall were within the historical range at most depths, while pH in summer and winter were generally above the historical maxima (i.e., more alkaline) at all depths.

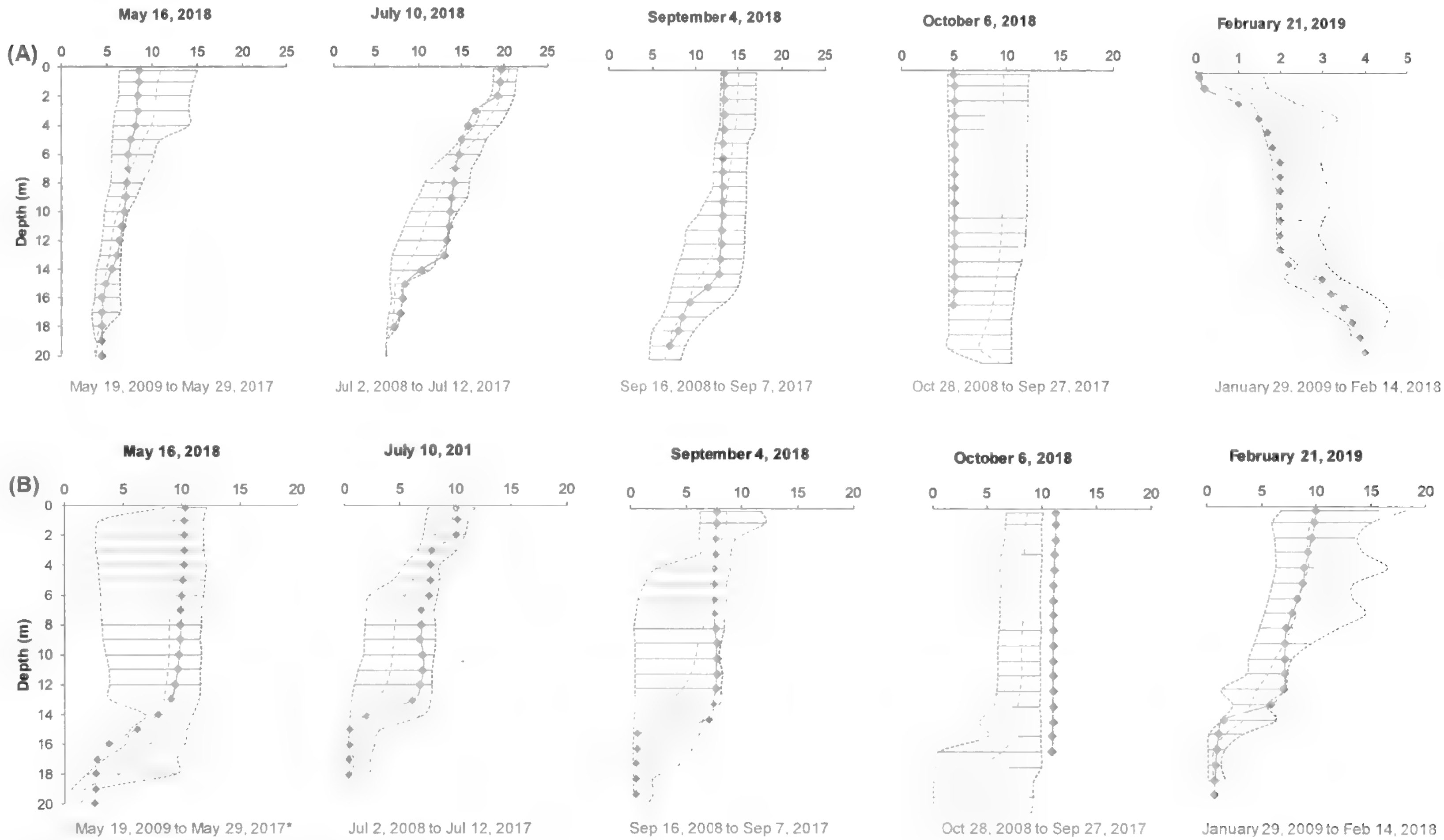
The conductivity profiles showed small increases near the lake bottom during May and September 2018 and February 2019, but overall there was no evidence of a chemocline in 2018/2019 (Figure 3.4). Conductivity was within the range of historical observations in all seasons, except a small number of measurements near the lake bottom in July and February, which were above the historical maxima for those water depths (Figure 3.4).

Figure 3.1 Daily average water temperature collected at one-meter intervals from the surface to bottom of Horizon Lake, December 22, 2017 to February 22, 2019[1].



[1] Data were missing for: December 22, 2017 to May 15, 2018 at 4 meters; and May 16 to July 9, 2018 at 3m. Data were replaced with the average temperature from logger above and below in the water column on each day.

Figure 3.2 Temperature (A) and dissolved oxygen (B) profiles collected from Horizon Lake between May 2018 and February 2019, compared to the historical range observed from 2008 to 2017.

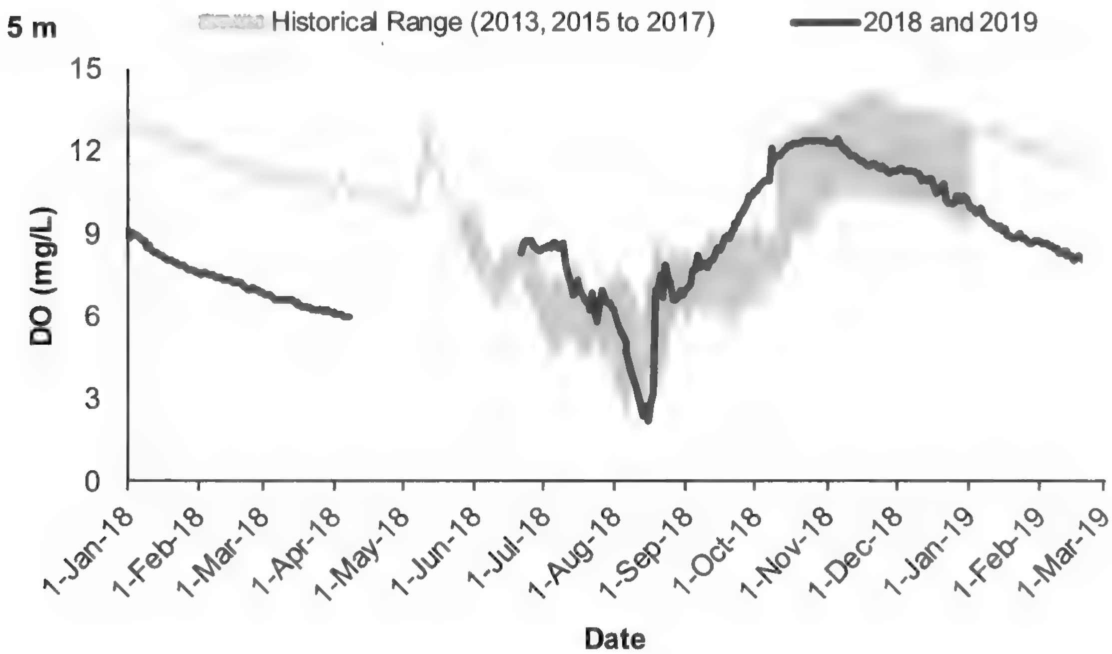


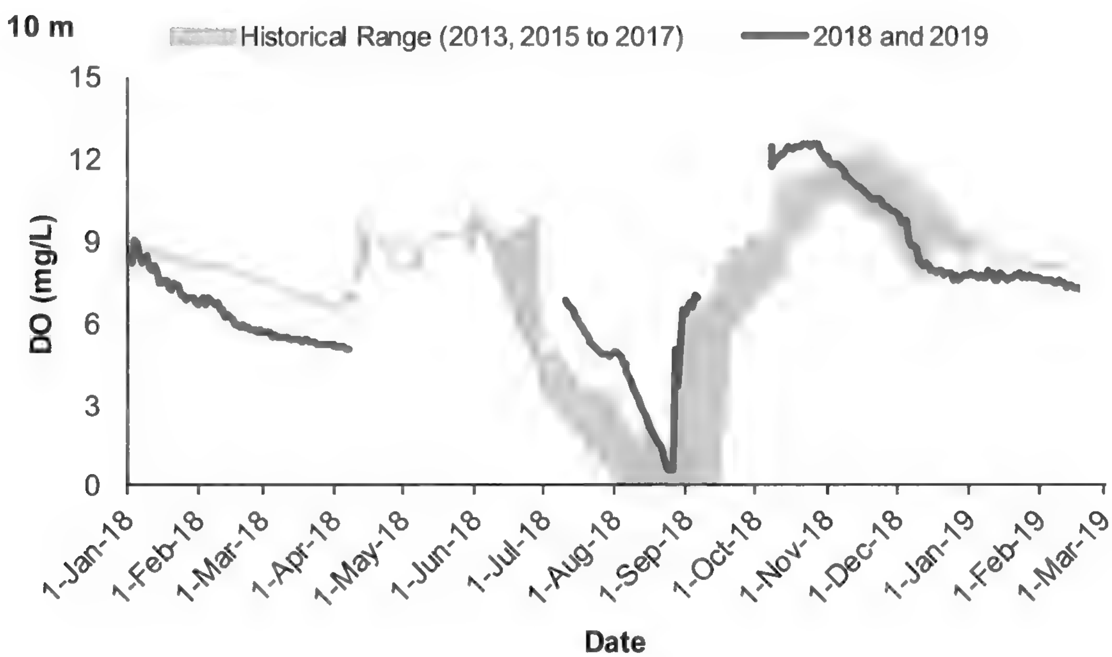
Coloured line represents 2018 and 2019 observations.

Dashed lines represent minimum, average, and maximum of historical data (sample date range provided below each figure).

* DO probe malfunctioned on May 24, 2016; data not included.

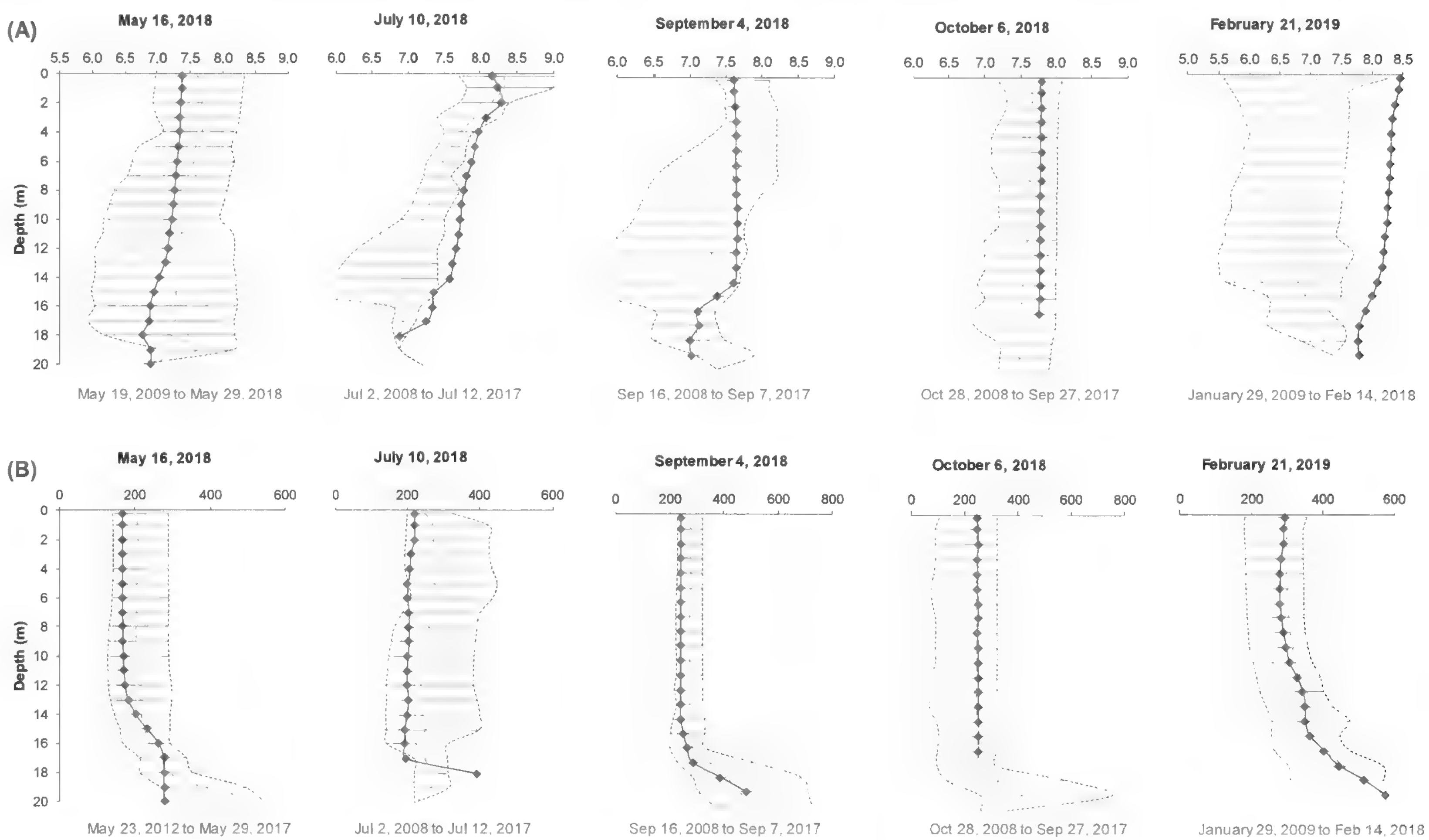
Figure 3.3 **Comparison of daily average dissolved oxygen concentrations measured at 5 m and 10 m depth intervals in Horizon Lake, 2013 and 2015 to 2019.**





Note: no data available for 2014.

Figure 3.4 pH (A) and conductivity (B) profiles collected from Horizon Lake between May 2018 and February 2019, compared to the historical range observed from 2008 to 2017.



Coloured line represents 2018 and 2019 observations.

Dashed lines represent minimum, average, and maximum of historical data (sample date range provided below each figure).

3.1.2 Water Chemistry

Concentrations of key water quality endpoints measured in Horizon Lake in fall 2018 and winter 2019 are summarized in Table 3.1 with graphs of select water quality variables measured from 2008 to 2018 provided in Figure 3.5. Figure 2.6 summarizes how data are presented within these graphs. Raw lab reports are provided in Appendix A9.

Seasonal and inter-annual variability in the select water quality analytes have been relatively low since 2008 (Figure 3.5). Most of the seasonal variability observed to date is due to regular events like freshet and lake turnover, although inter-annual variability has also been observed in response to specific climactic events, such as the flood conditions during the spring of 2013 and the very dry period that occurred during the spring of 2015. Compared to previous years, there were no substantial increases in metals concentrations in 2018 and 2019 except total mercury; the concentration in February 2019 (6.4 mg/L) was higher than recent years (ranging from 0.63 mg/L to 1.4 mg/L between 2015 and 2018) but remained within the 95th percentile of historical observations (Figure 3.5). A review of the entire water quality dataset for the Program shows similar analyte concentrations and levels of variability across years, suggesting water chemistry has remained relatively stable since the lake was created in 2008.

The majority of analytes were within the range of water quality guidelines for the protection of aquatic life (CCME 2014 and GoA 2018) in fall 2018 and winter 2019, with the exception of total phenols and total iron (fall) and total mercury (winter); however, all analytes were within the range of historical observations (Table 3.1 and Figure 3.5).

Total iron concentrations measured in fall 2018 exceeded the guideline value for protection of aquatic life (Government of Alberta 2018 and CCME 2014) (Table 3.1), which was not unexpected considering 73% of samples (n=55) collected from the lake between winter 2008 and winter 2019 have exceeded this guideline. The iron guideline has also been exceeded in every sample (n=128) collected from the mouth of the Tar River (TAR-1) and upstream of Horizon Lake (TAR-2 and TAR-2A) between 1998 and 2017 (www.ramp-alberta.org; 2017 data provided by AEP). Elevated levels of iron are present in surface waters throughout the region, and are commonly observed in areas where groundwater moves through acidic (high redox potential) soils, such as those present in muskeg/peatlands. Acidic soil conditions prevent dissolved iron in groundwater from adsorbing to a solid phase, resulting in higher concentrations of iron being carried through to the surface water drainage network (Küsel et al 2008).

Total phenols also exceeded water quality the guidelines value for the protection of aquatic life (Government of Alberta 2018 and CCME 2014) in fall 2018. In total, 44% of samples (n = 55) collected from Horizon Lake have exceeded guidelines since 2008. This was lower than observations in the upper and lower Tar River, where 59% of samples (n = 59) have exceeded between 1998 and 2017 (www.ramp-alberta.org; 2017 data provided by AEP). Similar to iron, high concentrations of phenols are naturally occurring in many streams and lakes of northeastern Alberta due to the prevalence of organic soils (i.e., peat) in the region (CCME 1999b, Sparling and Hennick 1974). The guidelines for both of these water quality analytes are conservative and the small exceedances that have been observed were not expected to adversely affect fish or other biota in the lake.

Total mercury exceeded the chronic water quality guideline for the protection of aquatic life (5 ng/L; Government of Alberta 2018) in winter 2019. Total mercury has exceeded guidelines in 13% of samples (*n*=53) collected in Horizon Lake since 2008, while no samples have exceeded the acute Alberta guideline (13 ng/L; Government of Alberta 2018) or the federal CCME guideline (26 ng/L; CCME 2014) for the protection of aquatic life. Similarly, 12% of samples (*n* = 121) collected from the upper and lower Tar River between 2003 and 2017 (www.ramp-alberta.org; 2017 data provided by AEP) have exceeded the chronic water quality guideline in Alberta, with 2% exceeding the acute guideline and 1% exceeding the CCME guideline.

In 2018, the concentrations of total boron, total molybdenum, and total aluminum were below water quality guidelines for the protection of aquatic life (CCME 2014), were within the range of previous observations in Horizon Lake (Table 3.1), and were within the range of concentrations observed in the Tar River between 2002 and 2017 (TAR-1 and TAR-2; www.ramp-alberta.org; 2017 data provided by AEP). These results indicate low potential for chronic toxic effects on the aquatic life of Horizon Lake.

Dissolved phosphorus in winter 2018 was above the historical maximum observed in Horizon Lake (Table 3.1 and Figure 3.5); however, the concentration of dissolved phosphorus in Horizon lake during winter 2019 had declined, to slightly below the historical median (Table 3.1 and Figure 3.5).

The seasonal composition of major ions in Horizon Lake is presented in Figure 3.6, which includes all fall and winter data collected since 2008. The ionic composition of Horizon Lake exhibits patterns of seasonal variability that appear consistent from year-to-year, with the lowest ion concentrations generally observed in fall and highest in winter. Cations have remained stable interannually in both fall and winter, while anions showed high variability interannually, with most of the variability accounted for by chloride (both seasons) and bicarbonate (predominantly fall).

The trophic status index (TSI) for the lake was 61 in fall 2018 and 42 in winter 2019 (Figure 3.7), suggesting a eutrophic system in fall and mesotrophic system in winter (Wetzel 2001). Historically, the lake has generally been classified as a eutrophic system, with 68% of the measurements indicating eutrophic conditions (Figure 3.7). Nutrient status based on the N:P ratio (Guildford and Hecky 2000) indicates that the lake has generally been phosphorous limited (55% of measurements; N:P > 50) or co-limited (42% of measurements; N:P 20 – 50) (Figure 3.8). The lake was co-limited in fall 2018 and strongly phosphorous limited in winter 2019.

Table 3.1 Concentrations of select water quality measurements in Horizon Lake, 2008 to 2019.

Analyte	Units	Guideline	Horizon Lake		Historical		
			2018	2019	2008-2018[a]		
			Fall	Winter	Min	Max	Median
Physical variables							
Conductivity	µS/cm	-	240	310	140	360	281.5
Hardness	mg/L	-	110	140	63	170	130
pH	pH units	6.5-9.0	8.01	8.11	7.6	8.6	8.06
Total Suspended Solids	mg/L	-	3.3	1	<1	41	2.6
Total Dissolved Solids	mg/L	-	180	150	100	240	160
Total Alkalinity	mg/L	-	95	120	<0.5	220	110
Nutrients							
Chlorophyll-a	ug/L	-	18	<0.5	<0.5	52	5
Total nitrogen	mg/L	-	0.61	0.65	0.5	1.97	0.8
Nitrate+Nitrate	mg/L	-	0.02	0.086	<0.003	0.47	0.17
Ammonia	mg/L	0.018-130[b]	0.033	<0.015	0.01	0.13	0.05
Total phosphorus	mg/L	-	0.053	0.014	0.011	0.13	0.0355
Total dissolved phosphorus	mg/L	-	0.0073	0.011	0.005	0.056	0.015
Dissolved organic carbon	mg/L	-	17	19	9	23	16
Ions							
Sodium	mg/L	-	8.1	11	5	16	11
Bicarbonate	mg/L	-	120	150	55	270	133
Calcium	mg/L	-	30	37	16	47	36
Potassium	mg/L	-	1.1	1.5	1	2.3	1.6
Magnesium	mg/L	-	8.3	11	4.8	13	10
Chloride	mg/L	120-640	1.5	1.3	<0.5	9	1.2
Sulphate	mg/L	128-429[c]	27	34	24	58	36
Organic compounds							
Naphthenic acids	mg/L	-	<1	<1	<1	1	1
Total petroleum hydrocarbon	mg/L	-	<2	<2	<2	2	<2
Total phenols	mg/L	0.004	***0.0065***	0.004	<0.002	***0.036***	<0.002
Selected metals							
Total arsenic	mg/L	0.005	0.0016	0.00073	<0.0002	0.00208	0.001
Total aluminum	mg/L	0.1	0.051	0.022	<0.003	**0.944**	0.037
Dissolved aluminum	mg/L	0.05, 0.1	<0.003	0.0039	<0.0004	***0.257***	0.011
Total boron	mg/L	1.5-29	0.051	0.056	<0.02	0.08	0.0605
Total molybdenum	mg/L	0.073	0.0013	0.0014	<0.0002	0.002	0.0012
Total mercury	ng/L	5, 13, 26	0.42	**6.4**	0.06	**9**	2

Table 3.1 (Cont'd.)

Analyte	Units	Guideline	Horizon Lake		Historical		
			2018	2019	2008-2018[a]		
			Fall	Winter	Min	Max	Median
Other variables that exceeded guidelines							
Dissolved arsenic	mg/L	0.005	0.0012	0.00052	<0.0002	***0.039***	0.000885
Dissolved copper	mg/L	0.009-0.062[d,e]	0.00056	0.00051	0.000057	***0.011***	0.0011
Dissolved iron	mg/L	0.3	<0.06	<0.06	<0.06	***0.53***	0.073
Dissolved lead	mg/L	0.001-0.007[f]	<0.0002	<0.0002	<0.0002	***0.047***	0.00001
Dissolved selenium	mg/L	0.001[g]	<0.001	<0.0002	<0.0002	***0.0009***	0.0001
Dissolved zinc	mg/L	0.03	<0.003	0.005	<0.003	***0.072***	0.002
Total Cadmium	mg/L	0.0004-0.0077[h,i]	<0.00002	<0.00002	<0.00002	***0.00003***	<0.000005
Total iron	mg/L	0.3	***0.32***	0.12	0.06	***1.54***	***0.21***
Total lead	mg/L	0.001-0.007[f]	<0.0002	<0.0002	<0.0002	***0.0069***	0.00021
Total silver	mg/L	0.00025	<0.0001	<0.0001	<0.0001	***0.000455***	0.000003
Total zinc	mg/L	0.007[j]	<0.003	0.0033	<0.003	***0.07***	0.0031
Sulphide[k]	mg/L	0.0019	<0.0019	<0.0019	<0.002	*0.013*	*0.002*

Note: Each sample consisted of a composite from the three mid-lake sites (HZL-1, HZL-2, and HZL-3).

Guidelines sourced from Government of Alberta (2018) and CCME (2014).

Bold italic values indicate concentrations exceeding guidelines for the protection of aquatic life.

[redacted] indicate concentrations below observed historical minimum values for Horizon Lake.

Orange cells indicate concentrations above observed historical maximum values for Horizon Lake.

a: Historical data includes results from February 2018.

b: (Ammonia) Guidelines for total ammonia are temperature and pH dependent; see CCME (2014) and AESRD (2014) for additional information

c: (Sulphate) Hardness-dependent Guideline = 128 mg/L at hardness 0-30 mg/L, 218 mg/L at hardness 31-75 mg/L, 309 at hardness 76-180 mg/L, 429 mg/L at hardness 181-250 mg/L

d: (Copper) Hardness-dependent. Guideline =0.2*e(0.8545*[ln(hardness)]-1.465)/1000; 0.002 at [CaCO3]=0 to 82 mg/L; 0.004 at [CaCO3]>180 mg/L

e: (Copper) Hardness-dependent. Guideline = e(0.979123*[ln(hardness)]-8.64497)/1000

f: (Lead) Hardness-dependent. Guideline = 10(1.273*[ln(hardness)]-4.705)/1000; 0.001 at [CaCO3]=0 to 60 mg/L; 0.007 at [CaCO3] >180 mg/L 0.007 at [CaCO3]>180 mg/L"

g: (Selenium) Alert concentration = 0.001 mg/L; Guideline = 0.002 mg/L.

h: (Cadmium) Hardness-dependent. Guideline = 0.04 µg/L at [CaCO3]= 0 to 17 mg/L, guideline = 10(0.86[log(hardness)]-2.46)/1000 at [CaCO3]=17 to 280 mg/L, 0.37 µg/L at [CaCO3] >280 mg/L

i: (Cadmium) Hardness-dependent. Guideline = 0.11 µg/L at [CaCO3]= 0 to 5.3 mg/L, guideline = 10(1.016[log(hardness)]-1.71)/1000 at [CaCO3]= 5.3 to 360 mg/L, 7.7 µg/L at [CaCO3]>360 mg/L

j: (Zinc) The long-term CWQG is for dissolved zinc and is calculated using the following equation: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). The value in the table is for surface water of 50 mg CaCO3·L−1 hardness, pH of 7.5 and 0.5 mg·L−1 DOC. The CWQG equation is valid between hardness 23.4 and 399 mg CaCO3·L−1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L−1.

k: Sulphide was measured as H2S from 2008 to 2015; a direct measurement of total sulphide has been used from 2016 onwards.

Figure 3.5 Concentrations of select water quality endpoints measured in Horizon Lake, 2008 to 2019.

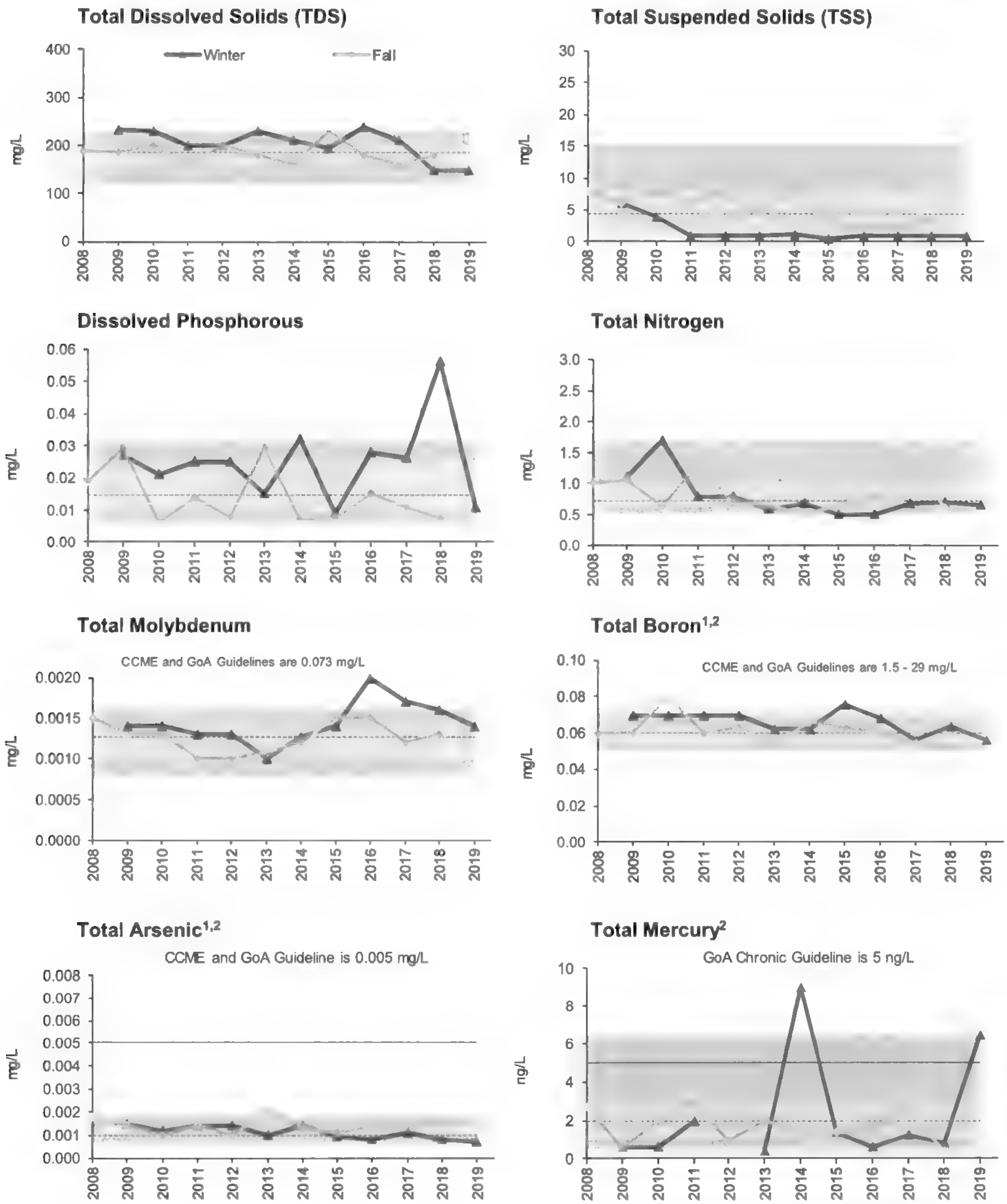
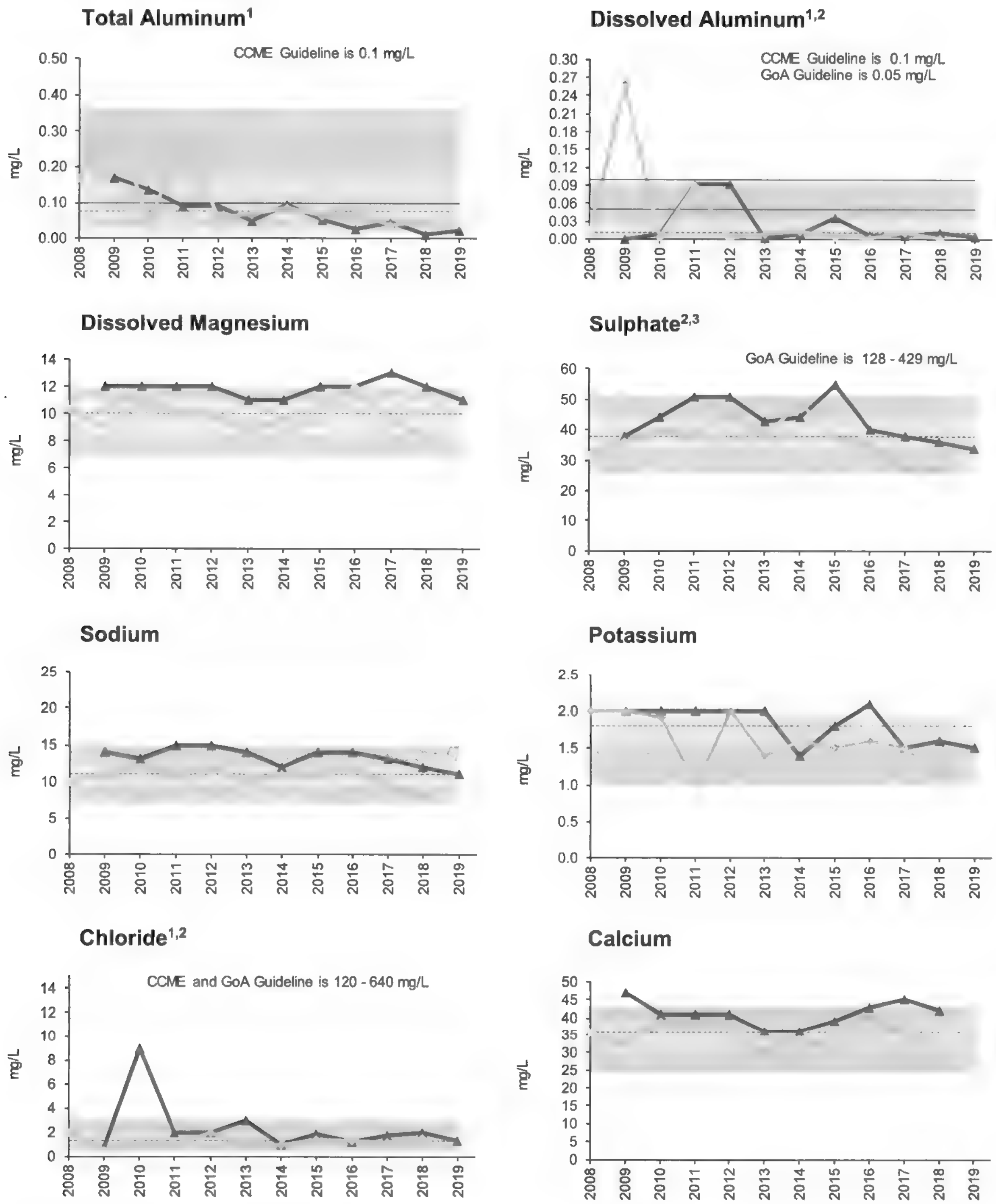


Figure 3.5 (Cont'd.)



Non-detectable values are shown at the detection limit.

——— Water quality guideline (where applicable)

1 Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (CCME 2014)

2 Surface Water Quality Guidelines for use in Alberta (GoA 2014)

3 Guideline is hardness dependent

Grey shading represents the full range of results observed to date in Horizon Lake (Sept 2008 to Feb 2018)

Figure 3.6 Piper diagram of ion concentrations in Horizon Lake, 2008 to 2019.

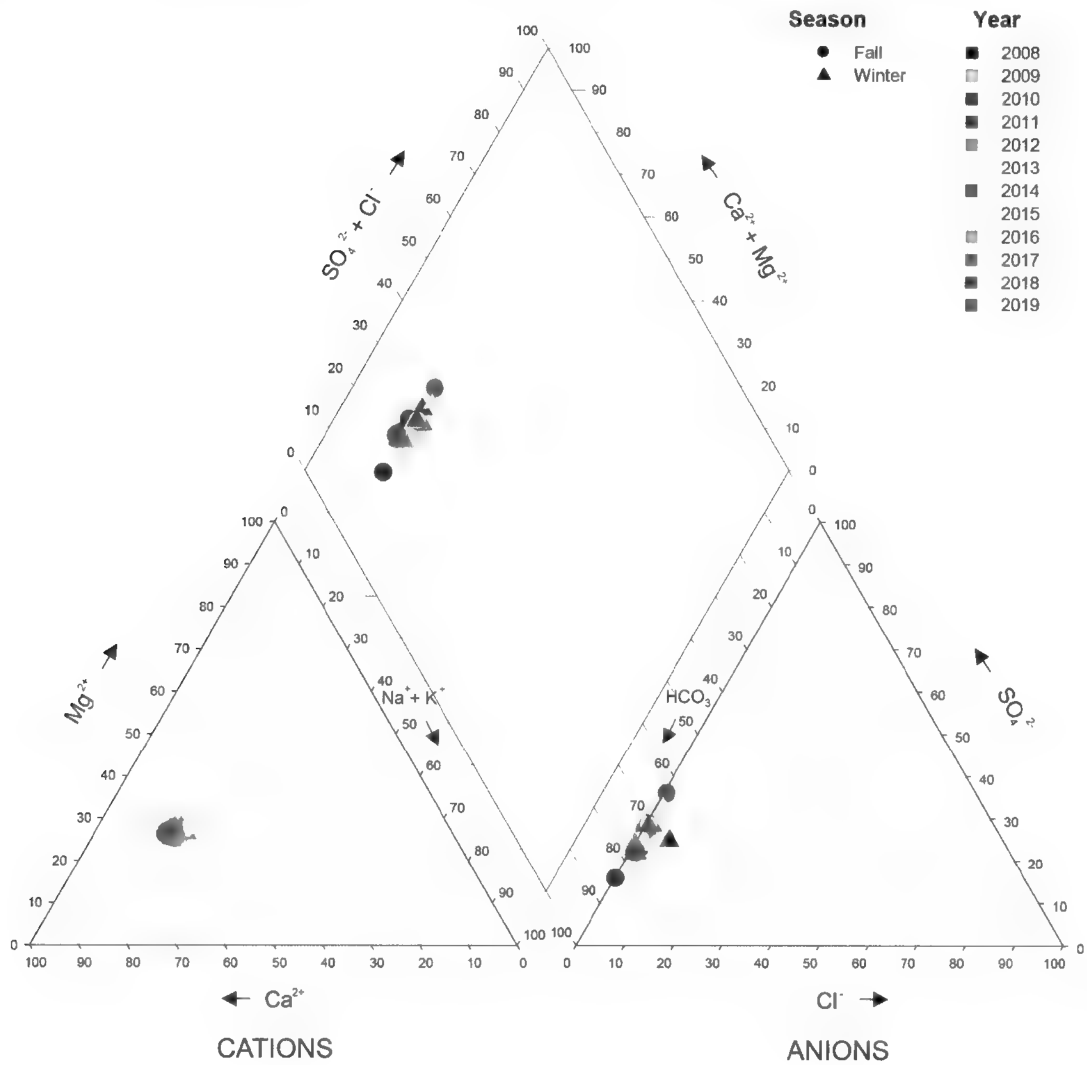


Figure 3.7 **Seasonal trophic status for Horizon Lake, calculated using the TSI Index (Wetzel 2001), 2008 to 2019.**

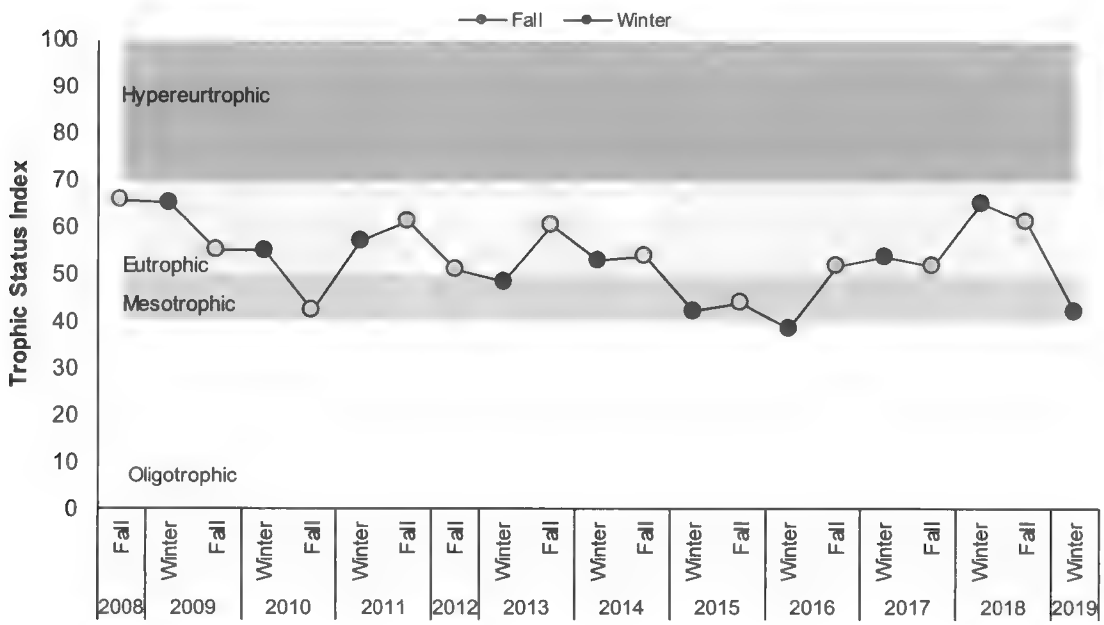
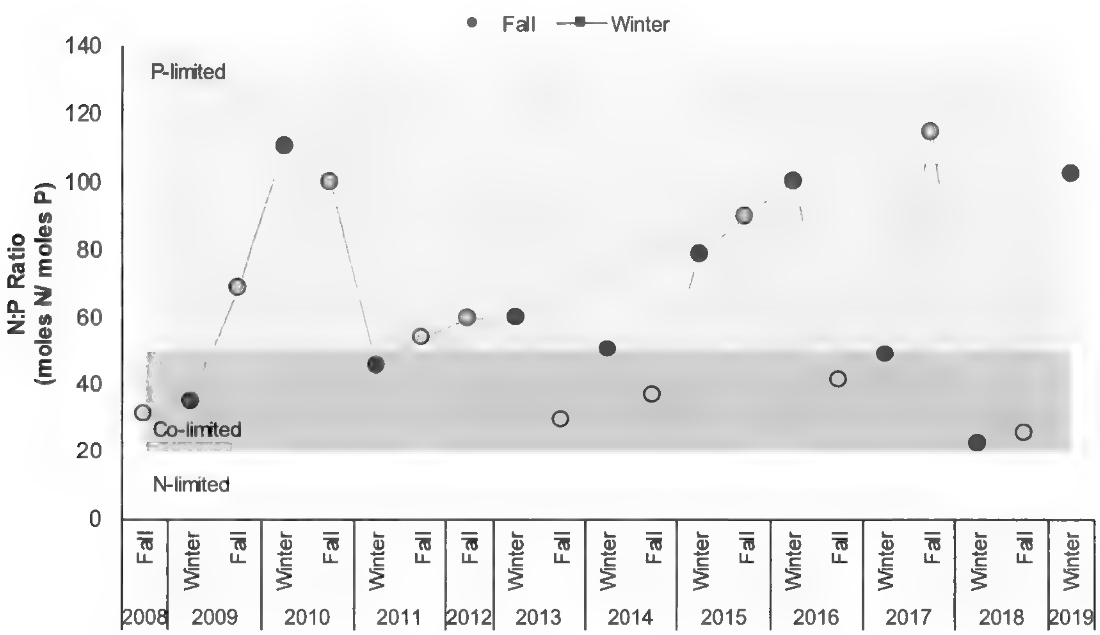


Figure 3.8 **Seasonal nutrient status for Horizon Lake, calculated using molar N:P ratio, 2008 to 2019.**



3.1.2.1 Regression Analysis

The temporal variability of select water quality variables measured in Horizon Lake are presented in Figure 3.5. Analytes showing evidence of increasing or decreasing concentrations over time ($p<0.05$) are presented in Figure 3.9; analytes that are not increasing or decreasing over time are presented in Appendix A9.

The results of the regression analysis provide evidence of decreasing concentrations for total suspended solids ($p = 0.009$) and total aluminum ($p = 0.045$) in fall (Figure 3.9). Seven analytes show evidence of winter decreases over time (Figure 3.9), including: total dissolved solids ($p = 0.032$), total nitrogen ($p=0.034$), total aluminum ($p < 0.001$), total arsenic ($p = 0.004$), dissolved potassium ($p = 0.029$), dissolved sodium ($p = 0.037$), and total suspended solids ($p = 0.026$).

The relationship with TSS was leveraged by high values in 2009 (6 mg/L) and 2010 (4 mg/L), with all observations since 2011 near or below detection limit (1 mg/L).Total aluminum is highly correlated with TSS, which has also decreased in both fall and winter since 2008. Total aluminum intermittently exceeded the CCME water quality guideline for the protection of aquatic life (CCME 2014) between 2008 and 2014, with all subsequent observations below the guideline.

Decreases in total nitrogen loading may represent the tail-end of a nutrient pulse from the vegetation that was submerged following lake construction. Overall, nitrogen concentrations in fall and winter have remained low, ranging from 0.5 to 1.7 mg/L (Figure 3.9).

Total arsenic has the potential to negatively impact the health of aquatic life. In 2018, concentrations of arsenic in Horizon Lake sediments were above the CCME ISQG (Section 3.2) and above human health consumptions guidelines in fish tissue (Section 3.5.2.2); however, concentrations in fish tissues remained within the range of the reference watershed. Total arsenic in water appears to be decreasing over time in Horizon Lake and has remained below CCME and Alberta water quality guidelines for the protection of aquatic life (CCME 2014 and Government of Alberta 2018) since monitoring began in 2008.

Dissolved potassium and dissolved sodium are indicators of ion balance, which have the potential to be affected by discharges or seepages from oil sands development, or by changes in the relative influence of groundwater. Although winter concentrations appear to be decreasing over time, the absolute change in concentrations was minor (range from 11 to 15 mg/L for sodium and 1.4 to 2.1 mg/L for potassium) and not ecologically meaningful.

Figure 3.9 Water quality variables that showed significant ($p<0.05$) trends in (A) Fall, and (B) Winter, 2008 to 2019.

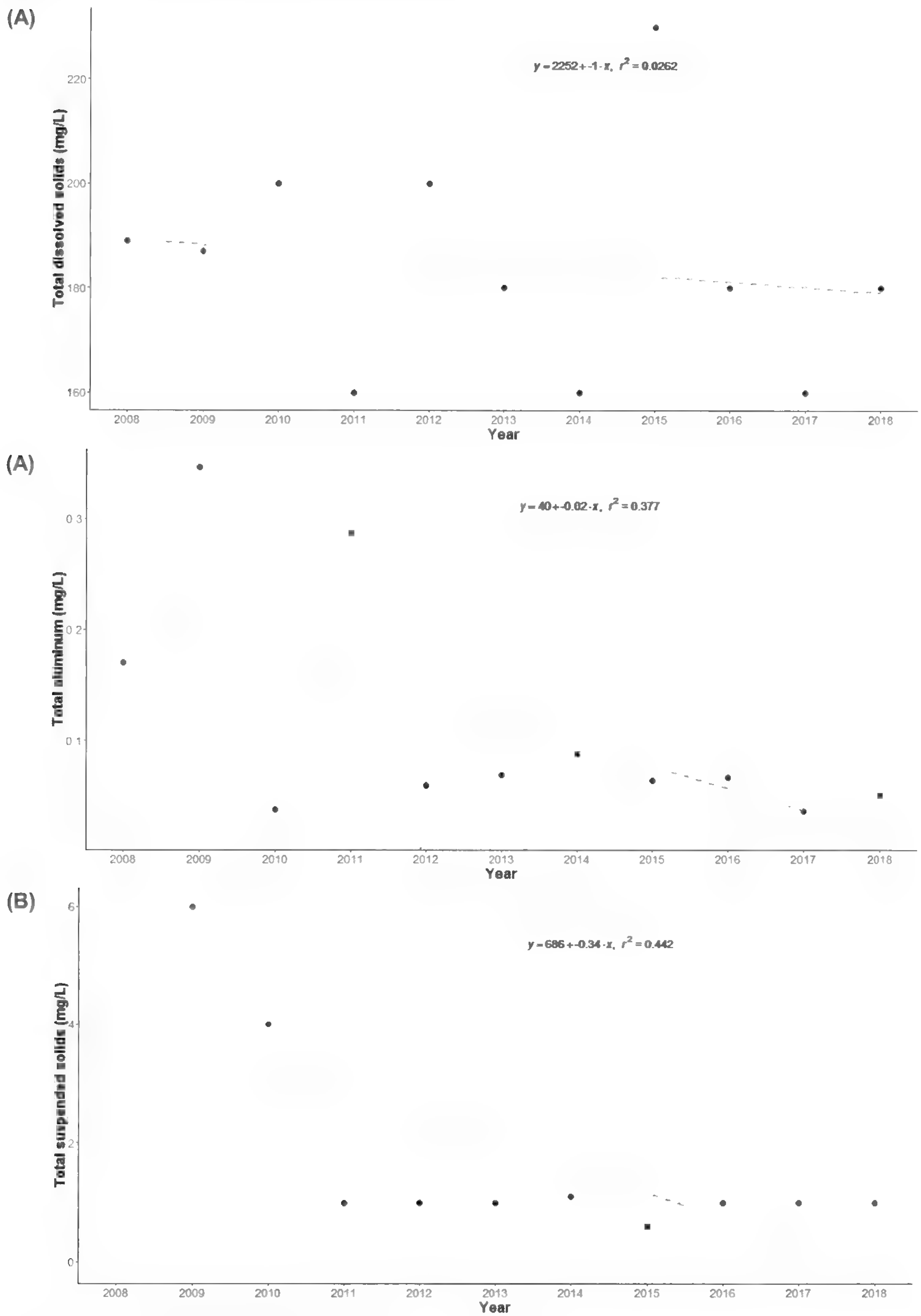
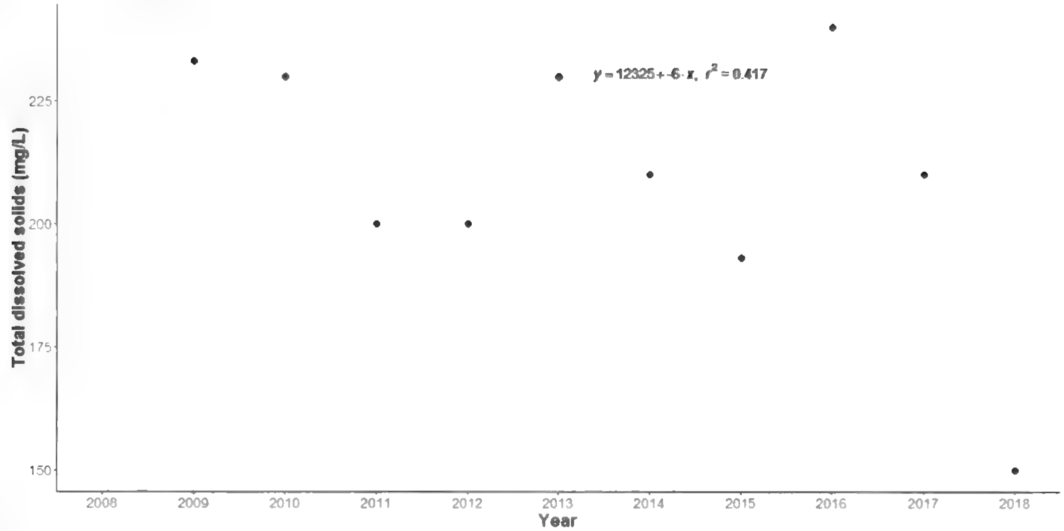
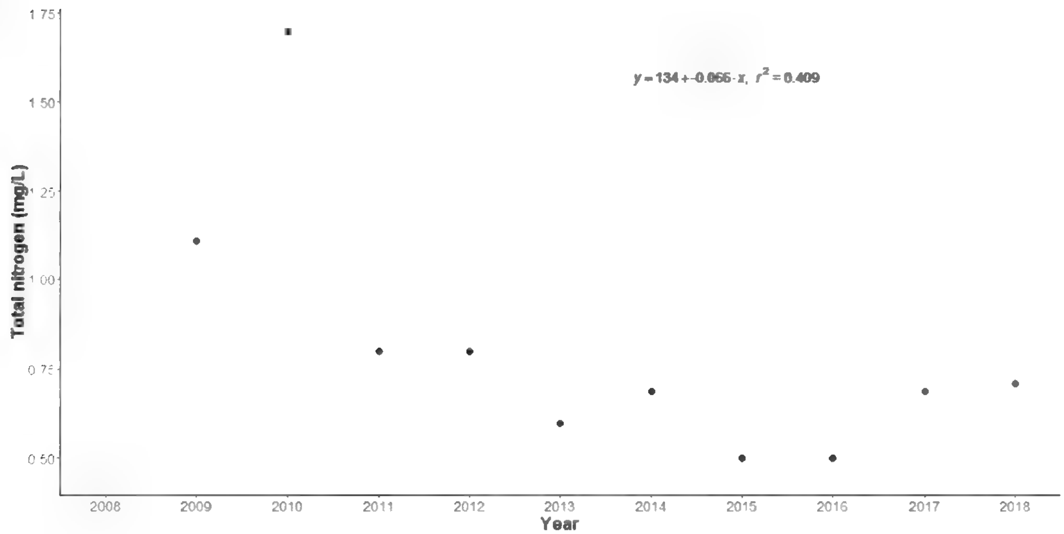


Figure 3.9 (Cont'd.)

(B)



(B)



(B)

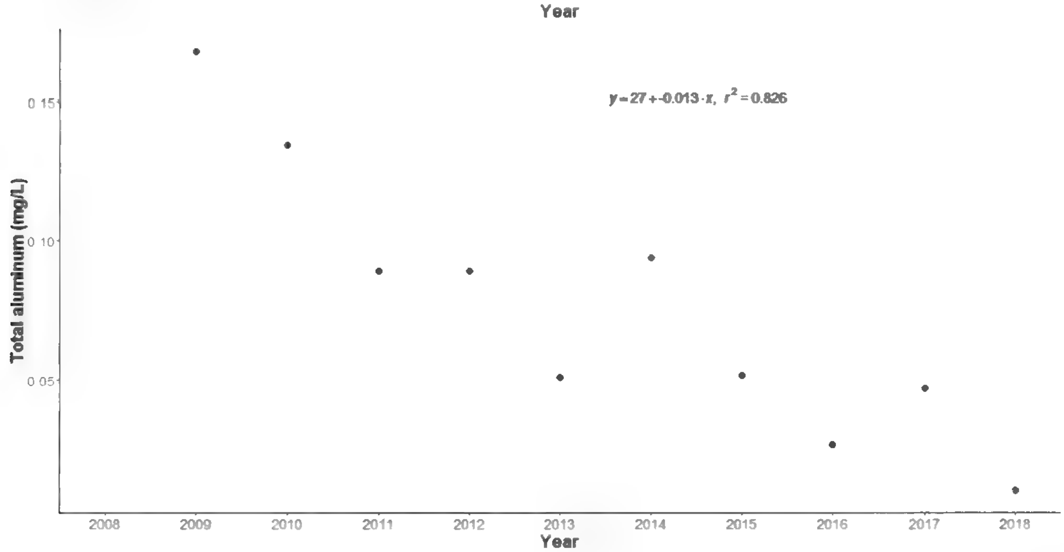
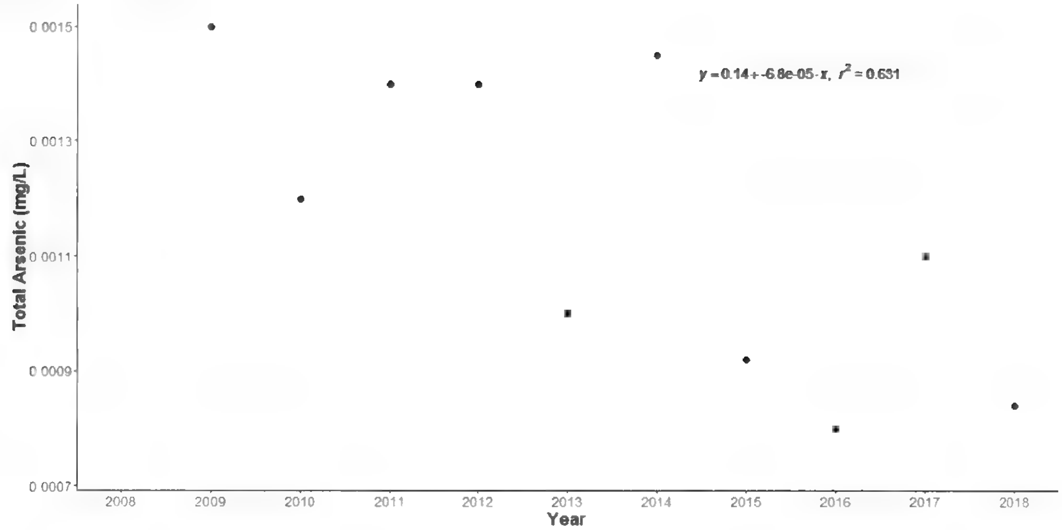
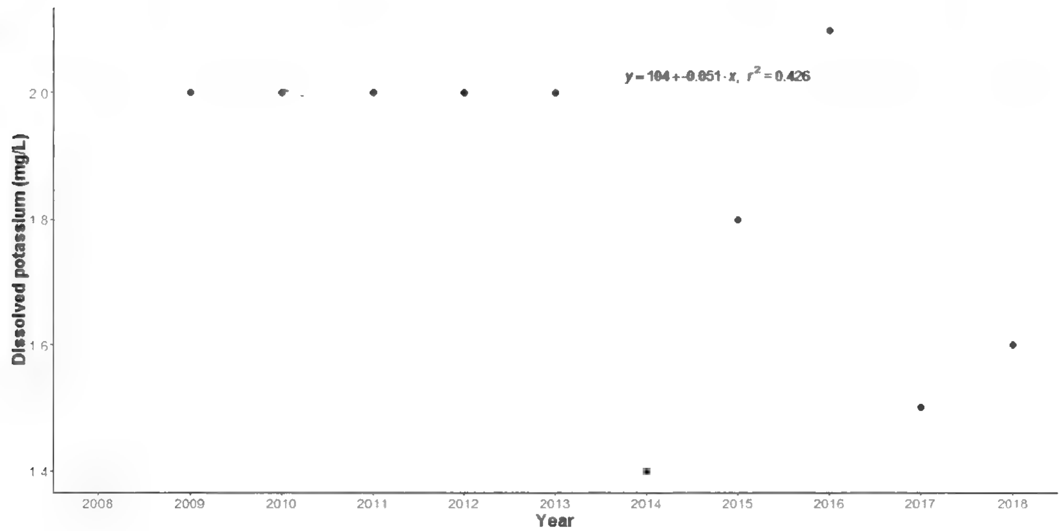


Figure 3.9 (Cont'd.)

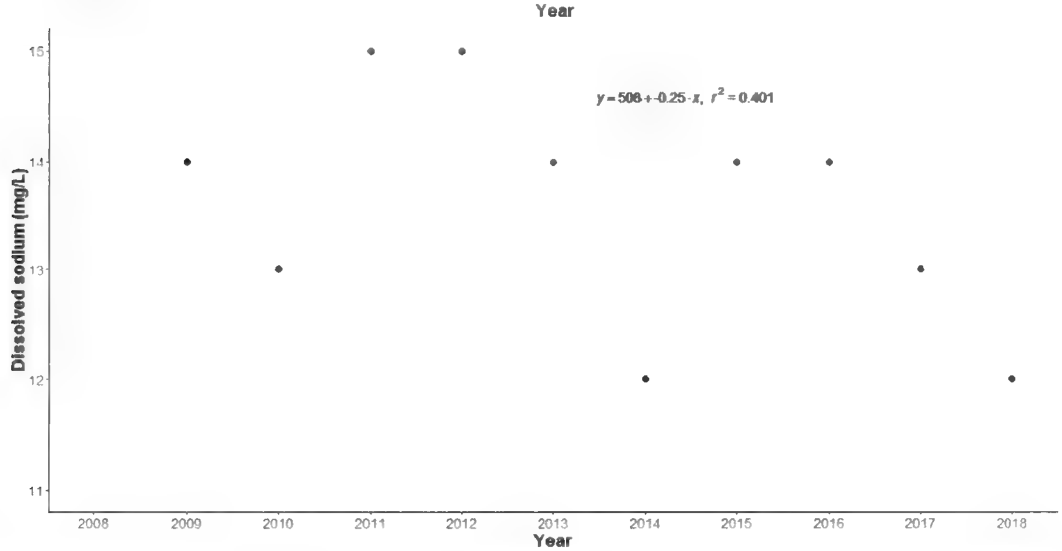
(B)



(B)



(B)



3.2 SEDIMENT QUALITY

Select sediment quality endpoints measured in samples collected from the three deep-water sites (BEN-1, BEN-2, and BEN-3) in September 2018, and the historical minimum and maximum values recorded since sampling began in 2009 are presented in Table 3.2; the complete sediment quality dataset for 2018 is provided in Appendix A10.

The particle size composition at BEN-1 was comprised primarily of silt, with the composition of silt slightly higher than previous years (Table 3.2); the bay that BEN-1 is located in diffuses the kinetic energy of the Tar River, and this would be expected to cause suspended solids to be deposited to the lake bed. The particle size composition at BEN-2 and BEN-3 was predominately clay; the clay percentage at BEN-2 was higher than previous years, while the composition at BEN-3 was within the range of previous years.

Concentrations of mercury and zircon exceeded the historic maximums at all three sites in 2018 (Table 3.2). Concentrations of barium, cobalt, iron, lead, potassium, strontium, uranium, vanadium, and zinc were also above the historical maximums in at least one sample in 2018. All 2018 metals concentrations were below applicable interim sediment quality guidelines (ISQG) and probable effects levels (PEL) at all three lake sites, with the exception of arsenic, which has exceeded in all previous years of sampling in Horizon Lake (Table 3.2). Exceedances of the total arsenic ISQG have also been observed previously in the Tar River; of the 15 samples collected between 1998 and 2015, seven samples from the mouth and one sample from upstream of Horizon Lake exceeded the CCME ISQG (www.ramp-alberta.org). According to the full regional dataset available from www.ramp-alberta.org, 75 of 433 samples (17%) have exceeded the ISQG guideline for arsenic, with the highest percent of exceedances occurring in Eymundson Creek (3 of 3 samples exceeded), Shipyard Lake (12 of 14 exceeded), and Isadore's Lake (9 of 11 exceeded).

Low molecular-weight compounds (Fraction 1 including BTEX, and Fraction 2) are highly volatile and have high aqueous solubilities that allow transport through the water column, making them more bioavailable (and toxic) to freshwater aquatic life (AENV 2001). In contrast, higher molecular weight hydrocarbons (Fractions 3 and 4) have much lower aqueous solubilities, resulting in compounds that are more persistent in the environment but have less potential for toxic effects. In 2018, hydrocarbon concentrations at all three sites were below detection limits, with the exception of Fraction 3 (C16-C34) at BEN-2 and BEN-3 (Table 3.2); the concentration of Fraction 3 was below the ISQG at both sites, and below the range of historical observations at BEN-3.

3.2.1 PAH Toxicity

PAH hazard index (HI) values were calculated using measurements of total PAH and total hydrocarbons (both obtained through analytical testing) as discussed in Section 2.2.2.1. Sediments exhibiting a hazard index greater than 1.0 have the potential to be toxic to aquatic biota (Neff et al 2005), although it is important to consider that the PAH toxicity benchmark of 1.0 is intended to protect sensitive species against both acute and chronic toxic effects, and may not fully reflect tolerances of local organisms (USEPA 2004). It is also possible for sediments that are above the threshold of 1.0 to be non-toxic if there are site-specific partitioning conditions that reduce the bioavailability of these compounds (USEPA 2004).

HI values were 0.05 (BEN-1) and 0.06 (BEN-2 and BEN-3) in 2018 and were within the range of historical observations at all sites (Table 3.2). Concentrations of all PAH were below ISQ and PEL guidelines in 2018 (Table 3.2). The results of this hazard assessment suggest there is low potential for PAH and total hydrocarbon related toxic effects on the aquatic life of Horizon Lake.

Table 3.2 Concentrations of sediment quality endpoints measured in Horizon Lake, 2009 to 2018.

Measurement Variable	Units	Guideline		BEN-1			BEN-2			BEN-3		
		ISQG	PEL	2018	2009-2016[1]		2018	2009-2016[1]		2018	2009-2016[1]	
					Min	Max		Min	Max		Min	Max
Physical Variables												
Moisture[2]	%	-	-	59	52	70	68	41	71	72	74	85
Total Organic Carbon[2]	%	-	-	3.2	1.6	3.9	2.0	1.5	2.3	2.3	2.4	3.0
Sand[2]	%	-	-	11	2.9	22	16	14	55	15	3.1	7.6
Silt[2]	%	-	-	59	24	58	35	12	41	32	23	46
Clay[2]	%	-	-	29	24	73	49	34	44	53	50	74
Texture[3]	-	-	-	silty clay loam	heavy clay, silt/loam		Clay	sandy clay loam		Clay	heavy clay	
Total Petroleum Hydrocarbons												
BTEX[3]	mg/kg	-	-	<24	<24	<36	<31	<12	<26	<35	<36	<44
Fraction 1 (C6-C10)[4,5]	mg/kg	30	-	<24	<5	<36	<31	<5	<26	<35	<5	<44
Fraction 2 (C10-C16)[2,5]	mg/kg	150	-	<24	<21	70	<31	<10	70	<35	<38	120
Fraction 3 (C16-C34)[2,5]	mg/kg	300	-	<120	70	260	170	59	193	230	280	***457***
Fraction 4 (C34-C50)[2,5]	mg/kg	2800	-	<120	70	<160	<160	<50	<120	<180	199	<200
Select Polycyclic Aromatic Hydrocarbons												
Total PAHs	mg/kg	-	-	0.750	0.390	0.800	0.640	0.290	0.920	0.720	0.440	1.170
Total Parent PAHs	mg/kg	-	-	0.290	0.100	0.270	0.190	0.090	0.260	0.210	0.110	0.400
Total Alkylated PAHs	mg/kg	-	-	0.460	0.270	0.540	0.440	0.210	0.660	0.510	0.330	0.770
Predicted PAH toxicity[6]	H.I.	1	1	0.050	0.010	0.080	0.060	0.030	0.110	0.060	0.050	0.160
Acenaphthene	mg/kg	0.00671	0.0889	0.00192	0.00210	<0.00500	0.00119	0.000720	<0.00500	0.00116	0.00180	0.00600
Acenaphthylene	mg/kg	0.00587	0.128	<0.0000440	<0.000100	<0.00500	0.0000450	<0.0000760	<0.00500	0.0000470	<0.0000900	<0.00500
Anthracene	mg/kg	0.0469	0.245	0.000267	<0.000150	<0.00500	0.000238	<0.000140	<0.00500	0.000263	<0.000260	<0.00500
Benz(a)anthracene	mg/kg	0.0317	0.385	0.00170	0.00110	<0.00500	0.00168	<0.000550	<0.00500	0.00170	0.00170	<0.00500
Benzo(a)pyrene	mg/kg	0.0319	0.782	0.00487	0.00320	0.00900	0.00390	0.00120	***0.150***	0.00354	0.00300	0.00600
Chrysene	mg/kg	0.0571	0.862	0.0102	<0.00500	0.00940	0.00869	0.00310	0.0100	0.0101	<0.00500	0.0130
Dibenz(a,h)anthracene	mg/kg	0.00622	0.135	0.00195	0.00130	<0.00500	0.00170	0.000560	<0.00500	0.00207	0.00130	<0.00500
Fluoranthene	mg/kg	0.111	2.355	0.00362	0.00260	<0.00500	0.00252	0.00110	0.00600	0.00282	0.00270	0.0160
Fluorene	mg/kg	0.0212	0.144	0.00169	0.000300	***0.0250***	0.00145	<0.000180	0.0110	0.00145	0.000300	***0.0340***
Naphthalene	mg/kg	0.0346	0.391	0.000963	0.00140	0.0240	0.000963	0.000840	0.0340	0.000709	0.00130	***0.0390***
Phenanthrene	mg/kg	0.0419	0.515	0.00447	0.00340	0.0280	0.00357	0.00160	0.0110	0.00376	0.00390	0.0310
Pyrene	mg/kg	0.053	0.875	0.00575	0.00450	0.00800	0.00463	0.00190	0.00800	0.00501	0.00480	0.0150
Metals												
Total Aluminum	mg/kg	-	-	10400	5513	13000	11800	5434	16011	13800	7560	14000
Total Antimony[4]	mg/kg	-	-	0.500	0.200	<1.00	0.470	0.300	<1.00	0.520	0.200	<1.00
Total Arsenic	mg/kg	5.9	17	***13.7***	***8.70***	***15.0***	***12.6***	***10.3***	***11.8***	***13.9***	***9.90***	***20.4***
Total Barium	mg/kg	-	-	254	149	240	244	60	200	290	208	292
Total Beryllium	mg/kg	-	-	0.770	0.600	0.840	0.750	0.590	0.900	0.980	0.800	1.00
Total Bismuth[3]	mg/kg	-	-	0.240	<1.00	<1.00	0.260	<1.00	<1.00	0.320	<1.00	<1.00
Total Boron	mg/kg	-	-	15.8	11.0	18.4	14.9	5.10	19.2	19.9	7.80	31.1
Total Cadmium	mg/kg	0.6	3.5	0.431	0.300	***0.781***	0.399	<0.100	0.573	0.382	0.300	***0.694***
Total Calcium	mg/kg	-	-	5650	4690	6200	5340	4400	8156	5730	5800	7528

Table 3.2 (Cont'd.)

Measurement Variable	Units	Guideline		BEN-1			BEN-2			BEN-3		
		ISQG	PEL	2018	2009-2016[1]		2018	2009-2016[1]		2018	2009-2016[1]	
					Min	Max		Min	Max		Min	Max
Metals (Cont'd)												
Total Chromium	mg/kg	37.3	90	18.9	13.6	***45.9***	25.5	12.0	29.6	23.4	20.0	27.4
Total Cobalt	mg/kg	-	-	9.94	8.30	10.0	11.7	8.20	11.4	11.8	8.90	11.7
Total Copper	mg/kg	35.7	197	19.7	18.5	24.0	20.7	13.0	22.2	23.8	21.7	29.8
Total Iron	mg/kg	-	-	29000	22158	35000	29300	21340	28270	34500	27400	38939
Total Lead	mg/kg	35	91.3	13.4	10.8	15.0	14.8	9.40	13.3	17.4	12.5	18.7
Total Lithium[4]	mg/kg	-	-	15.8	9.62	19.0	17.6	10.3	18.7	21.1	18.2	21.4
Total Magnesium	mg/kg	-	-	3380	2787	4100	4140	2500	5131	4330	4000	4877
Total Manganese	mg/kg	-	-	704	386	780	686	433	800	701	368	812
Total Mercury[4]	mg/kg	0.17	0.486	0.0720	0.0340	0.0640	0.0730	0.0250	0.0570	0.0790	0.0420	0.0720
Total Molybdenum	mg/kg	-	-	1.45	0.800	2.50	1.29	1.00	1.50	1.71	1.40	1.90
Total Nickel	mg/kg	-	-	24.7	19.8	37.3	27.6	16.0	34.6	28.1	25.6	34.2
Total Phosphorus[4]	mg/kg	-	-	1070	811	1400	1070	376	1106	1360	1170	1926
Total Potassium	mg/kg	-	-	1750	910	1900	1970	1100	1630	2340	1572	2050
Total Selenium	mg/kg	-	-	1.06	0.700	1.30	0.820	<0.500	1.00	0.990	0.930	1.50
Total Silver	mg/kg	-	-	0.134	<0.200	<4.00	0.122	<0.200	<4.00	0.139	<0.200	<4.00
Total Sodium	mg/kg	-	-	122	117	304	144	108	332	188	180	378
Total Strontium	mg/kg	-	-	65.7	54.2	81.00	68.3	24.5	67.2	78.5	63.9	83.9
Total Thallium	mg/kg	-	-	0.263	0.100	<1.00	0.258	0.100	<1.00	0.288	0.200	<1.00
Total Tin[4]	mg/kg	-	-	0.580	<0.500	1.30	0.620	<0.500	1.00	0.720	<0.500	1.20
Total Titanium	mg/kg	-	-	38.8	30.0	101	30.2	30.0	227	31.8	27.0	99.3
Total Tungsten[7]	mg/kg			<0.50	-	-	<0.50	-	-	<0.50	-	-
Total Uranium	mg/kg	-	-	1.55	1.20	2.00	1.32	<1.00	1.30	1.55	1.30	1.90
Total Vanadium	mg/kg	-	-	34.8	19.7	36.2	37.6	22.0	34.6	42.1	28.0	39.4
Total Zinc	mg/kg	123	315	92.1	75.1	***125***	92.8	54.0	92.5	98.2	85.2	***128***
Total Zircon[8]	mg/kg	-	-	5.49	4.23	4.23	7.37	5.84	5.84	8.54	6.64	6.64

Values in bold italics indicate concentrations exceeding guidelines.
Values in [redacted] indicate 2018 concentrations below the range of previously observed values.
Values in orange indicate 2018 concentrations above the range of previously observed values.
Guidelines are from CCME (2001), unless otherwise noted.
[1]2008 sediment samples consisted of 6 grabs taken randomly throughout the lake and were not included in this table. Frequency of sediment sampling shifted to every second year following the 2012 program and therefore there are no data available for 2013, 2015, or 2017.
[2]Analyte not measured from 2010 to 2012.
[3]Analyte not measured from 2009 to 2012.
[4]Analyte not measured in 2009.
[5]Guideline is for residential/parkland coarse (median grain size > 75 µm) surface soils (CCME 2008).
[6]Toxicity of PAH assemblage estimated using the Neff et al. (2005) equilibrium partitioning approach. A hazard index (HI) is calculated from individual PAH concentrations in sediment, values of Kow (octanol-water partition coefficient), and chronic toxicity of the individual PAH species.
[7]Analyte not measured from 2009 to 2016.
[8]Analyte not measured from 2009 to 2014.

3.3 PHYTOPLANKTON AND ZOOPLANKTON

The metrics used to evaluate phytoplankton and zooplankton communities are discussed in Section 2.2.2. Complete phytoplankton and zooplankton taxonomy results from the 2018 sampling programs are provided in Appendix A11.

3.3.1 Phytoplankton

Average phytoplankton density was lowest in spring (1.5×10^6 cells/L) and highest in fall (2.8×10^6 cells/L) in 2018 (Figure 3.10). This is only the second time since monitoring began that phytoplankton density was highest in fall. Phytoplankton density has generally been highest in summer, except for 2012 and 2014. Average density in 2018 was within the range of previous observations in spring and fall, and below the historical minimum in summer.

Average phytoplankton biomass was also lowest in spring (611 µg/m³) and highest in fall (29,979 µg/m³) in 2018 (Figure 3.11). This is the second consecutive year that biomass was highest in fall. Historically, biomass has been highest in summer, with the exception of 2010. As with average phytoplankton density, biomass in 2018 was within the range of previous observations in spring and fall and below the historical minimum in summer.

Phytoplankton community composition in Horizon Lake included members of the groups *Bacillariophyceae* (diatoms), *Chlorophyceae* (green algae), *Chrysophycea* (golden algae), *Cryptophyceae* (brownish-green algae), *Cyanobacteria* (blue-green algae), *Dinophyceae* (dinoflagellates), and *Euglenophyceae* (Euglenophytes) in 2018 (Figure 3.10 and Figure 3.11).

Similar to the previous three years, the phytoplankton community was dominated by cryptophytes in 2018 (Figure 3.10). This was followed by diatoms and cyanobacteria, which have also been abundant in previous years. Cyanobacteria and dinoflagellates comprised the majority of biomass (44% and 43%, respectively) in 2018 (Figure 3.11). Cyanobacteria has been the most dominant taxa by biomass in all years except 2017, and dinoflagellates have also been within the top three taxa by biomass in all years except 2008 and 2017. The dissimilarity between the groups that contribute the majority of the density and the groups that account for the majority of the biomass is a result of the small size of certain taxa, which can greatly influence total abundance without having a large effect on total biomass. Xanthophyceae (yellow-green algae) have only been observed in the lake in two years (2009 and 2017; Figure 3.10); yellow-green algae are expected to be present in the lake in low numbers, making them less likely to be captured during quarterly sampling.

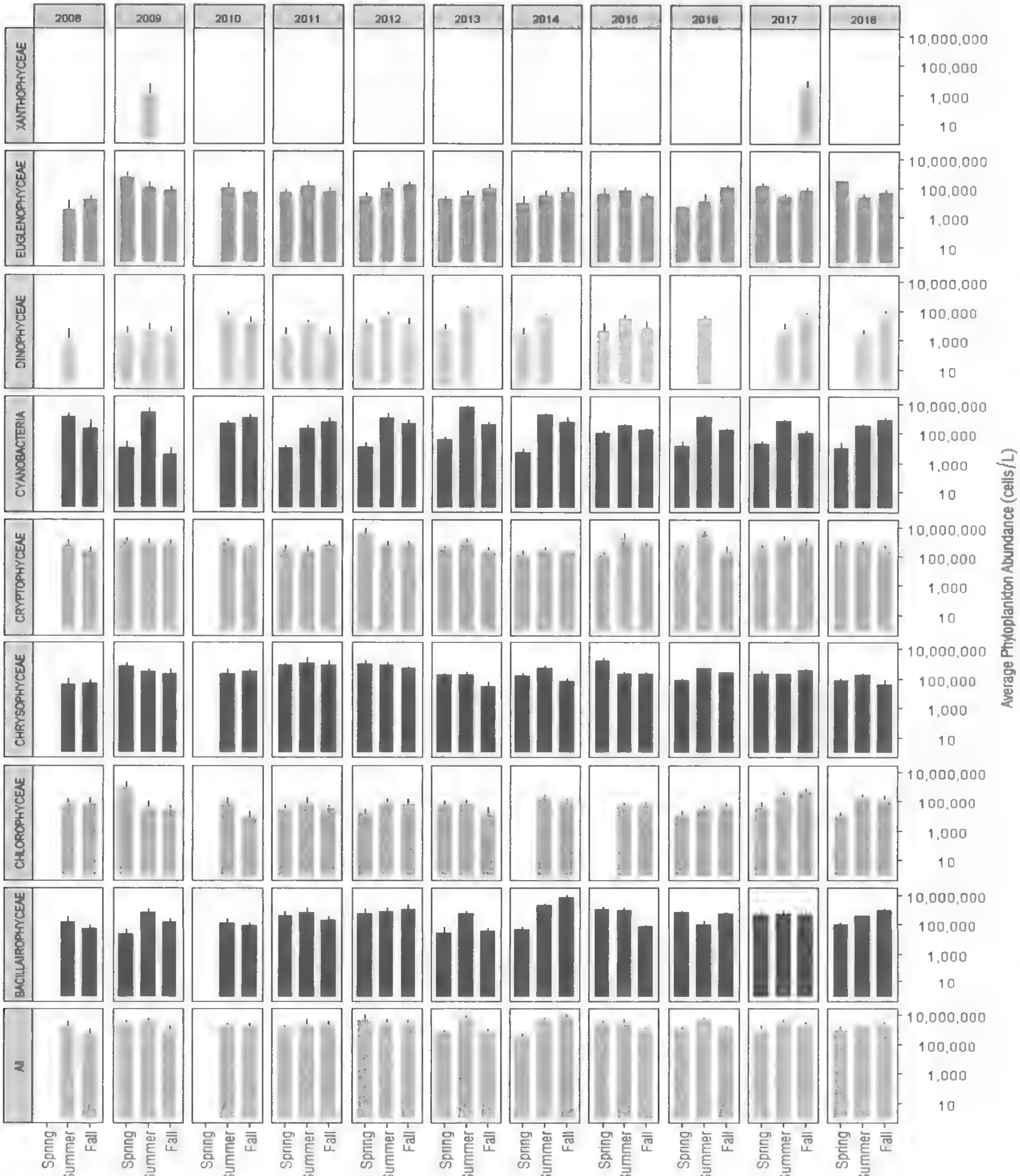
Mean species richness in 2018 ranged from 12 species in spring to 37 species in summer, which was the highest species richness observed in a season since monitoring began (Figure 3.12). Mean species richness has generally been highest in summer, with some exceptions (i.e., 2008, 2009, 2016, and 2017 when mean richness was highest in fall).

Mean Simpson's diversity in 2018 was lowest in spring (0.58) and highest in summer (0.74) (Figure 3.12). Mean diversity in 2018 was within the range of previous observations in spring and fall and higher in summer than all previous years. Horizon Lake has supported a moderate to highly diverse (≥ 0.50) phytoplankton community in all seasons each year, with the exception of summer 2013 and fall 2014 when the community was dominated by one taxa.

Mean evenness was lowest in summer (0.11) and highest in summer (0.20) in 2018 (Figure 3.12). The evenness index for phytoplankton communities in Horizon Lake have been relatively low since monitoring began in 2008, ranging from 0.07 (summer 2013) to 0.3 (fall 2013 and summer 2014). Low evenness indicates that the abundance of phytoplankton taxa is not equal and the Horizon Lake community is dominated by high abundance of a few taxa.

Phytoplankton communities are naturally dynamic, fluctuating both seasonally and temporally (Findlay et al. 2001; Calijuri et al. 2002; and Vasseur et al. 2005). This natural variability was observed in phytoplankton taxonomic richness, biomass, density, and community composition in Horizon Lake; however, there were no apparent seasonal or temporal trends in any of these metrics. Overall, there was some temporal variability in the dominant taxa from year-to-year, but overall the phytoplankton community in Horizon Lake is generally dominated by cryptophytes, diatoms, cyanobacteria, and dinoflagellates, with minor contributions of other taxa rounding out a moderately diverse community. These temporal changes in the community composition are likely caused by natural short-term changes in nutrient composition and other physical factors within the lake (e.g., fluctuations in water depth, wind mixing, and temperature).

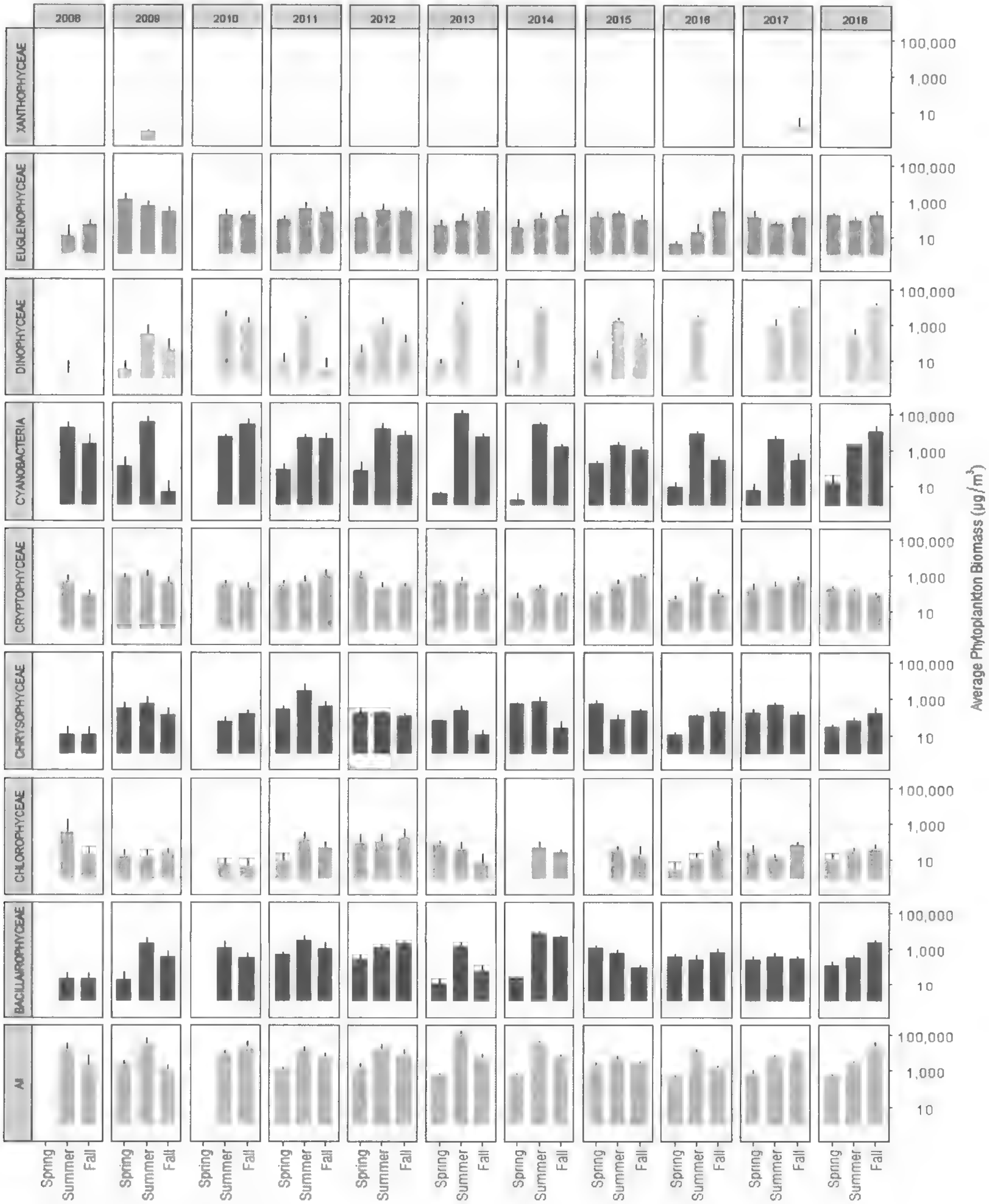
Figure 3.10 Average[1] phytoplankton abundance (cells/L) in Horizon Lake, 2008 to 2018.



Standard deviations are shown as error bars.

[1] Average of all replicates within individual year seasons (summer 2008; *n* = 12; fall 2008 *n* = 15; spring 2009 *n* = 9; summer and fall 2009 *n* = 12; spring 2010 *n* = 0; summer and fall 2010 *n* = 6; spring 2011 *n* = 3; summer and fall 2011 *n* = 6; each seasons in 2012 *n* = 6; each season from 2013 to 2018 *n* = 3).

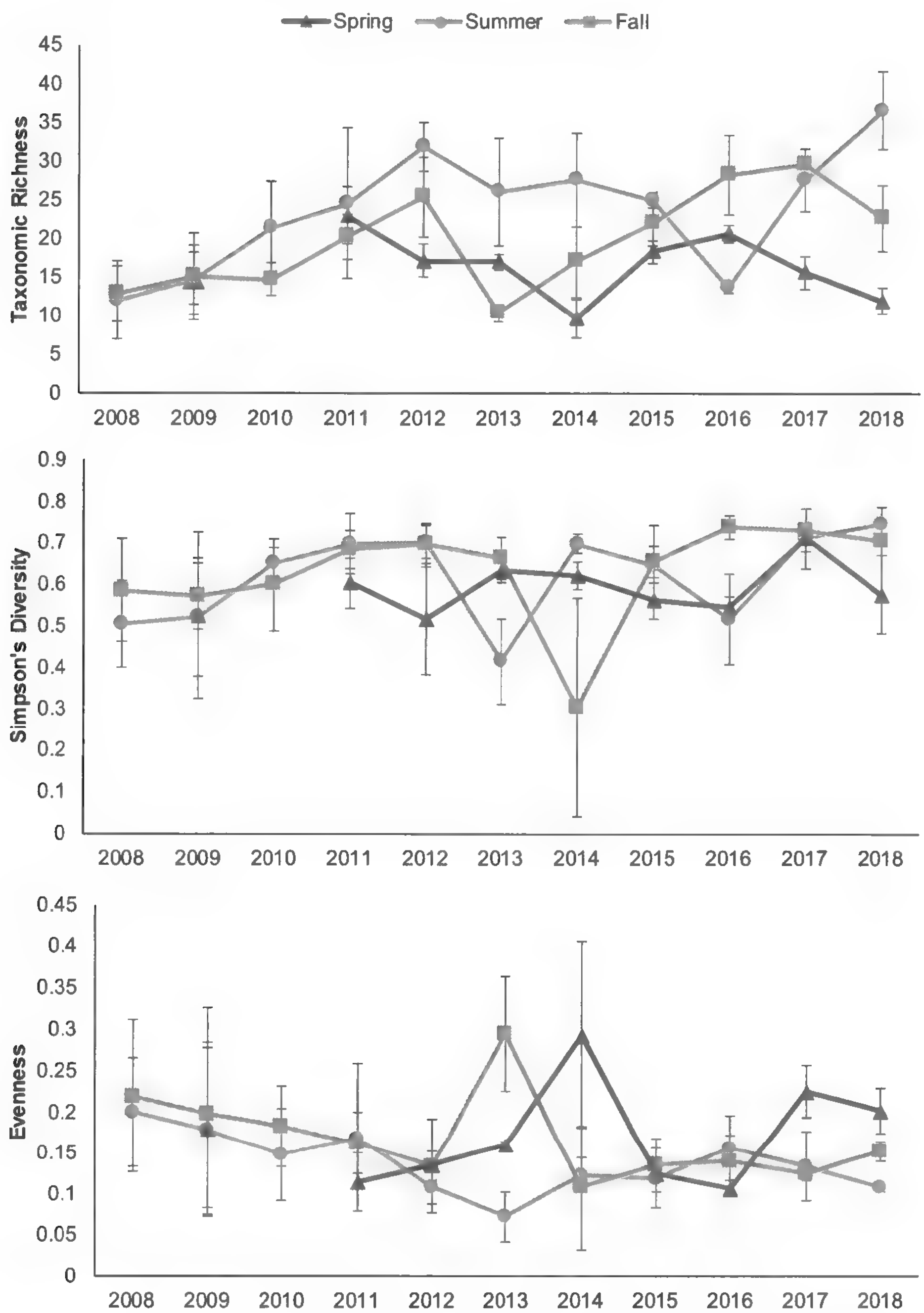
Figure 3.11 Average[1] phytoplankton biomass (µg/m³) in Horizon Lake, 2008 to 2018.



Standard deviations are shown as error bars.

[1] Average of all replicates within individual year seasons (summer 2008 n = 12; fall 2008 n = 15; spring 2009 n = 9; summer and fall 2009 n = 12; spring 2010 n = 0; summer and fall 2010 n = 6; spring 2011 n = 3; summer and fall 2011 n = 6; each season in 2012 n = 6; each season from 2013 to 2018 n = 3).

Figure 3.12 Average[1] taxa richness, Simpson's Diversity, and evenness of phytoplankton in Horizon Lake, 2008 to 2018.



Standard deviations are shown as error bars.

No sampling was undertaken in spring 2008 or spring 2010.

[1] Average of all replicates within individual year seasons (summer 2008 n = 12; fall 2008 n = 15; spring 2009 n = 9; summer and fall 2009 n = 12; spring 2010 n = 0; summer and fall 2010 n = 6; spring 2011 n = 3; summer and fall 2011 n = 6; each season in 2012 n = 6; each season from 2013 to 2018 n = 3).

3.3.2 Zooplankton

Average zooplankton density ranged from 7.7×10^4 organisms/m^3 in spring to 4.4×10^6 organisms/m^3 in summer in 2018 (Figure 3.13). Seasonal density patterns have been variable; this is the second consecutive year that the highest density was observed in summer, while 2013 was the last time density was lowest in the spring. Density of zooplankton in 2018 was within the range of previous years for each season.

Average zooplankton biomass was lowest in spring (1.1×10^5 µg/m^3) and highest in fall (2×10^6 µg/m^3) in 2018 (Figure 3.14). As with abundance, seasonal biomass patterns have been quite variable from year-to-year, although the lowest biomass has generally been observed in spring. Mean zooplankton biomass was within the range of previous years in all seasons in 2018.

As in previous years, the zooplankton community in Horizon Lake was comprised of members of the groups Calanoidia and Cyclopoida (copepods), Cladocera (water fleas), Ciliophora (ciliates), and Rotifera (rotifers) in 2018. Rotifers and ciliates were the highest contributors to density and biomass in all seasons in 2018; rotifers were the greatest density and biomass contributor in spring, ciliates were the most abundant and highest biomass group in summer, and in fall ciliates contributed the highest density while rotifers comprised the highest biomass. This pattern was also evident in 2017; however, rotifers generally made up the highest proportion of the density and biomass in all seasons from 2008 to 2016. The presence of ciliates has not been consistent from year-to-year, with observations in all three seasons only occurring in 2012, 2015, 2017, and 2018 (Figure 3.13 and Figure 3.14). Copepods from the group Cyclopoida made up a large proportion of the biomass in 2008 and 2009 but have been less prevalent in subsequent years. Copepods from the group Calanoida and water fleas continue to be small contributors to zooplankton community abundance.

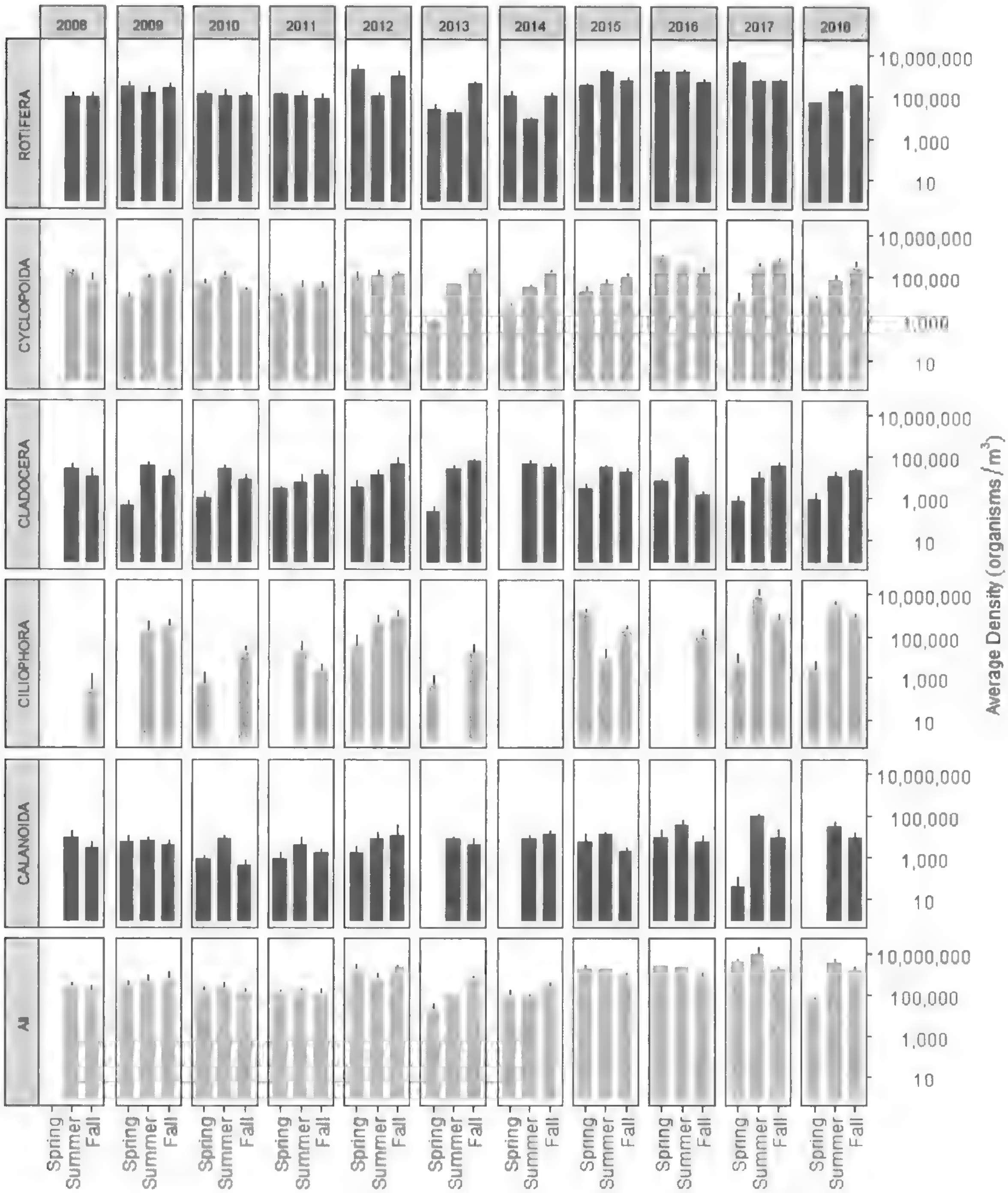
Mean species richness in 2018 was highest in fall (15) and lowest in spring (8), which was also lower than the historical spring minimum (Figure 3.15). Mean species richness in fall has been relatively stable from year-to-year (13 to 18 species), while higher variability has been observed in spring (8 to 19 species) and summer (11 to 19 species).

Mean Simpson's diversity was lowest in summer (0.15) and highest in fall (0.54) in 2018, which falls within the range observed in previous monitoring years (Figure 3.15). This is the fourth consecutive year that diversity was highest in fall, which previous to 2015 occurred in summer (except for 2011, when fall was also highest). The lower diversity observed in spring and summer was due to the high abundance of rotifers and ciliates, respectively, which made up over 80% of the zooplankton community. Overall, Horizon Lake currently supports a low to moderately diverse zooplankton community.

Mean evenness was highest in spring (0.19) and lowest in summer (0.09), which was also below the historical minimum summer observation (Figure 3.15). Evenness indices for zooplankton communities have been relatively low since monitoring began in 2008, ranging from 0.06 (spring 2012) to 0.24 (spring 2016). These low evenness scores indicate that the abundance of individual zooplankton is not equal and the community in Horizon Lake is dominated by a few taxa.

Similar to phytoplankton, zooplankton communities are naturally dynamic, fluctuating both seasonally and temporally (Rusak et al 2002 and Wu et al 2014). This natural variability has been observed in phytoplankton and zooplankton taxonomic richness, biomass, density, and community composition in Horizon Lake. Zooplankton communities In Horizon Lake are generally more variable in spring and summer and became more established and stabilized around the same levels in the fall. The seasonal and temporal changes in the community composition are likely caused by natural short-term changes in nutrient composition and other physical factors within the lake (e.g., fluctuations in water depth, wind mixing, and temperature).

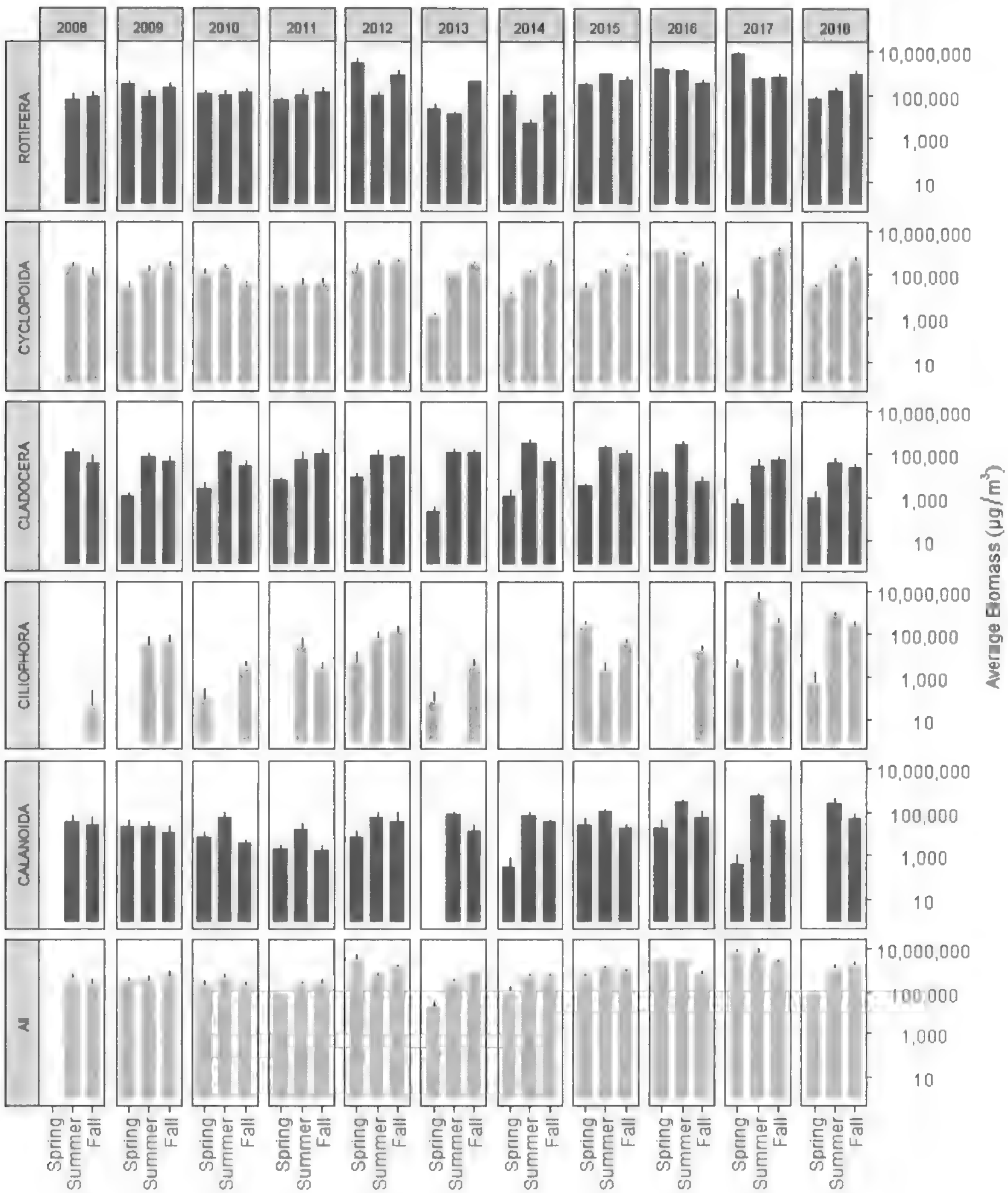
Figure 3.13 Average[1] zooplankton abundance (cells/L) in Horizon Lake, 2008 to 2018.



Standard deviations are shown as error bars.

[1] Average of all replicates within a season each year (summer 2008 n = 11; fall 2008 n = 15; spring 2009 n = 9; summer 2009 n = 11; fall 2009 n = 8; spring 2010 n = 3; summer and fall 2010 n = 6; spring 2011 n = 3; summer and fall 2011 n = 6; each season in 2012 n = 6; each season from 2013 to 2018 n = 3).

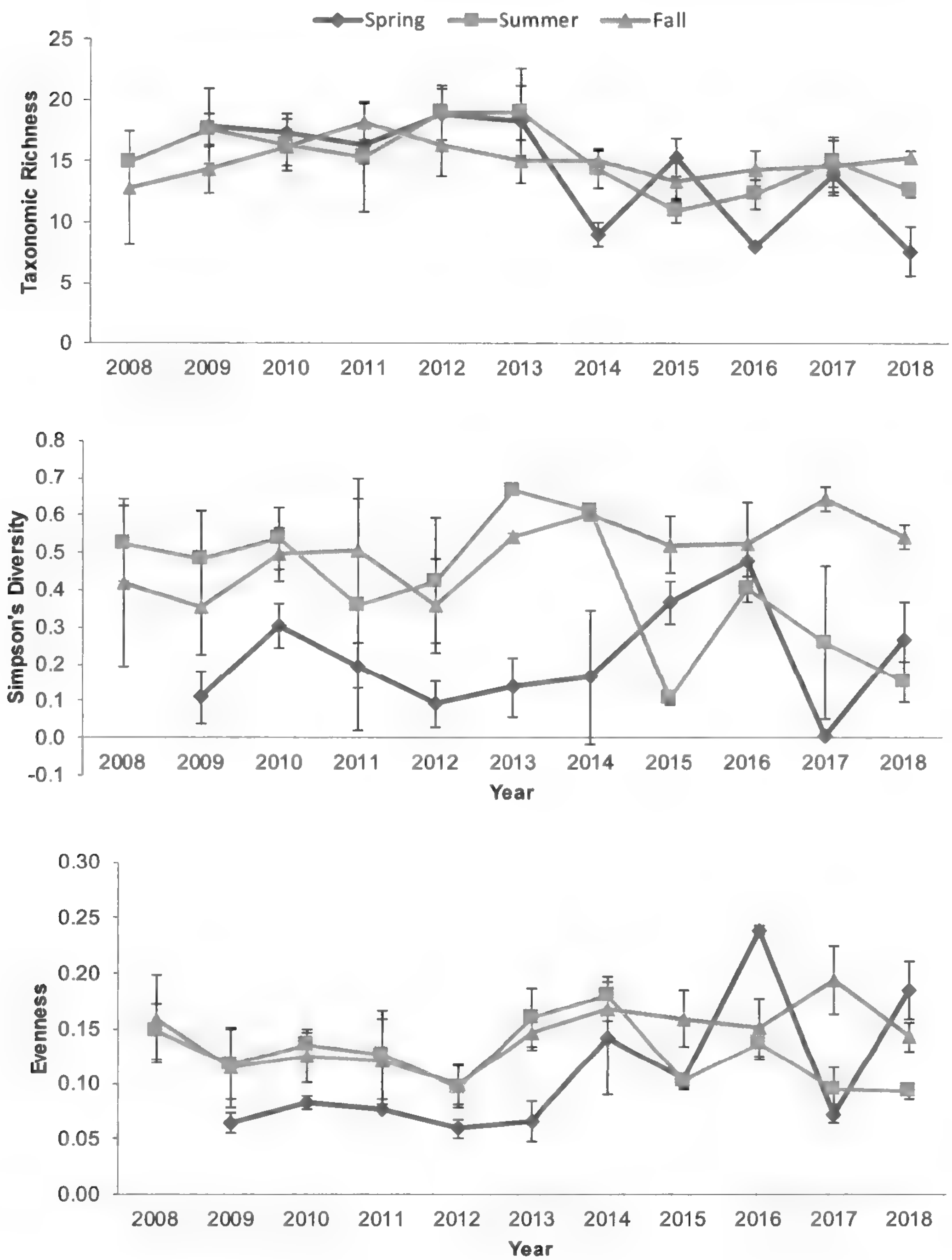
Figure 3.14 Average[1] zooplankton biomass (µg/m³) in Horizon Lake, 2008 to 2018.



Standard deviations are shown as error bars.

[1] Average of all replicates within a season each year (summer 2008 n = 11; fall 2008 n = 15; spring 2009 n = 9; summer 2009 n = 11; fall 2009 n = 8; spring 2010 n = 3; summer and fall 2010 n = 6; spring 2011 n = 3; summer and fall 2011 n = 6; each season in 2012 n = 6; each season from 2013 to 2018 n = 3).

Figure 3.15 Average[1] species richness, Simpson's diversity, and evenness in Horizon Lake, 2008 to 2018.



Standard deviations are shown as error bars.

No sampling was undertaken in spring 2008.

[1] Average of all replicates within a season each year (summer 2008 n = 11; fall 2008 n = 15; spring 2009 n = 9; summer 2009 n = 11; fall 2009 n = 8; spring 2010 n = 3; summer and fall 2010 n = 6; spring 2011 n = 3; summer and fall 2011 n = 6; each season in 2012 n = 6; each season from 2013 to 2018 n = 3).

3.4 BENTHIC INVERTEBRATES

Benthic invertebrate community metrics are summarized in Figure 3.16 to Figure 3.19. A compilation of raw benthic invertebrate data from 2018 is provided in Appendix A12. Near-shore benthic invertebrate samples from 2008 to 2016 were collected using a qualitative kick-net method (i.e., the number of invertebrates cannot be related to a unit bottom area) and these results are not comparable to the 2017 and 2018 near-shore sites or to the mid-lake and littoral sites that were sampled with an Ekman grab in all previous years.

Similar to previous years, average benthic invertebrate density was highest in the near-shore area (32,183 individual/m^2), followed by the littoral area (4,377 individuals/m^2) and the mid-lake area (1,299 individual/m^2) in 2018 (Figure 3.16 to Figure 3.18). This was expected given shallower lake regions generally have greater amounts of oxygen and primary production, higher habitat heterogeneity, and greater food resources available. Habitats that receive limited light exposure (i.e., deeper waters) are also known to deter colonization by many benthic invertebrate species. Average density at mid-lake and littoral sites in 2018 was within the range of previous years, while density at the near-shore site was lower than 2017 (Figure 3.16); temporal comparisons of the near-shore zone were limited because of the transition from kick-netting to grab sampling in 2017.

Pooled species richness was highest at the near-shore area, followed by the littoral and mid-lake areas (Figure 3.17). Similar to density, these differences are expected based on the higher-quality habitat generally found in shallower water. Trend analysis indicated that pooled richness is increasing in the mid-lake ($p = 0.040$, R^2 adjusted = 0.323, $n = 11$) and near-shore ($p = 0.002$, R^2 adjusted = 0.637, $n = 11$) areas; average richness per area follows a similar positive trend, though not significant. It is also worth noting an apparent 5-year cycle to the pooled richness in the mid-lake and littoral zones; starting from a minimum in year 1 (2008 and 2013 in Figure 3.17) and peaking in year 3 (2010 and 2015 in Figure 3.17). Following this pattern, we may expect pooled richness to increase in 2019 and 2020.

The Simpson's diversity index considers both species abundance and richness, with higher values (i.e., closer to 1.0) indicating greater community diversity. Average Simpson's diversity in 2018 was highest in the near-shore area (0.27) and lowest at the littoral area (0.18) (Figure 3.16). Average Simpson's diversity was within the range of previous years at the littoral and mid-lake areas and was slightly higher than 2017 in the near-shore area (Figure 3.16).

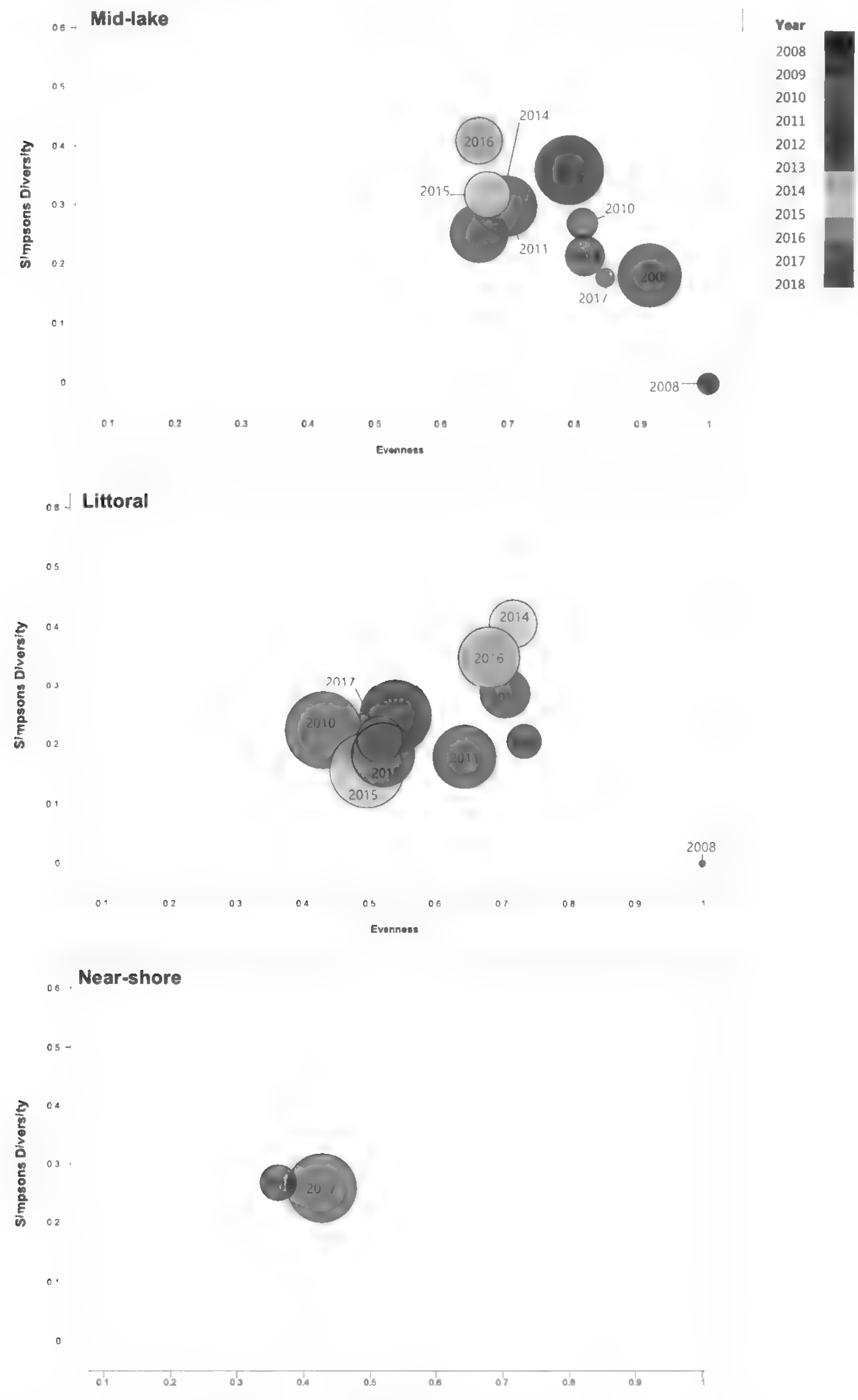
Evenness is a measure of the relative abundance of the different species in a community, with high evenness (i.e., values closer to 1.0) representing a balanced community without any dominant species. Average evenness ranged from 0.36 in the near-shore area to 0.81 in the mid-lake area in 2018. Average evenness was within the range of previous years at the littoral and mid-lake areas and slightly lower than 2017 at the near-shore area (Figure 3.16). The high average evenness observed in the mid-lake and littoral areas are likely driven by low richness, which will bias the calculation (an extreme example is a community with 1 taxon will have an evenness of 1.0). Evenness in the mid lake area generally decreased from 2008 to 2016, with increasing values observed in 2017 and 2018. This decrease appears to be driven by the high evenness observed in 2008 and 2009, when only one species was present in many samples collected at the mid-lake and littoral areas. Since 2010 there have been relatively small year-to-year differences in evenness at mid-lake sites, ranging from 0.66 (in 2013 and 2016) to 0.85 (in 2017).

Chironomid midges (Diptera: Chironomidae) were the dominant taxon in all areas in 2018. This was followed by phantom midges (Chaoboridae) and oligochaete worms at the mid-lake area, while the second most common taxon at the littoral and near-shore areas in 2018 was oligochaetes, consistent with historical samples. Both chironomids and oligochaetes are very common in fine sediment depositional areas, and their dominance in lentic grab samples is expected.

Sensitive ETO taxa were present at five of nine sites in 2018 (BEN-5 to 9); however these taxa were present at very low abundances, totaling <0.3 % ETO in all areas (Figure 3.18). All three orders tend to be associated with rooted macrophytes, woody debris, and rocky substrates due to their feeding preferences (scraping/shredding and predatory) and predator avoidance behaviours; only dragonflies (Odonata: Anisoptera) are considered effective-enough swimmers to escape predation if detected. In most cases, ETO individuals will use macrophytes and woody debris as refuge from predators, and as cover for hunting in the case of odonates; thus, if these habitats were not effectively sampled, the community results may be biased. Percent ETO has generally been low (less than 1%) at all areas in all years, with the exception of 2010 to 2012 (1.13 to 2.16 %) at the littoral area and 2013 to 2016 (1.22 to 14.3 %) at the near-shore area. Though found in low proportions, the increase in ETO in near-shore areas since 2012 (Figure 3.18) may reflect an overall improvement in habitat quality. A notable change in % ETO occurred between 2012 and 2013, where individuals appear to have moved from littoral to near-shore habitats. This switch may have been driven by an increase in near-shore habitat quality (e.g., more debris and/or macrophytes), a decrease in littoral habitat quality, or it may simply reflect sample bias/error. % ETO is likely to remain lower than 2013-2016 due to the change in sampling technique in 2017, because the Ekman grab is less effective than a sweep-net at capturing these organisms (especially most odonates). Regardless, the benefit of sampling all depth strata using the same consistent method (i.e., Ekman grab) is that it allows for the direct comparison of benthic communities among all sites of Horizon Lake.

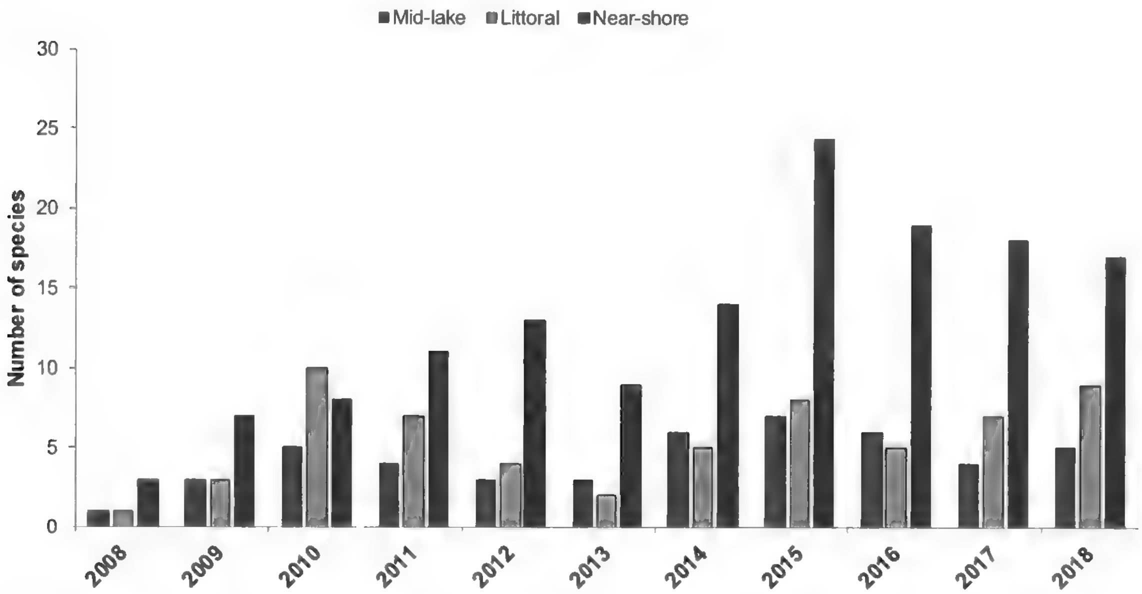
Benthic invertebrate communities have been dominated by collector-gatherers at all stations in all years, with the exception of mid-lake sites in 2009 and 2017. Near-shore benthic invertebrate communities have generally contained a higher number of functional feeding groups, including macrophyte herbivores, omnivores, scrapers, and shredders. This is indicative of a greater number of food sources available closer to shore, such as assorted aquatic vegetation, inputs from shore, and adequate nutrients and light for periphyton and phytoplankton to flourish. There was one functional feeding group observed in the mid-lake and littoral stations when monitoring began in 2008 (Figure 3.19), and although the number of groups increased following this first year, the total number of functional feeding groups has remained low over the past 10 years (n = 2 to 5) at these two depth strata. This is expected given the limited light exposure (i.e., deeper waters), which is known to deter colonization by many benthic invertebrate species. The number of functional feeding groups at the near-shore stations was low during the first two years of monitoring (n=2) and increased to a maximum of nine in 2015 (Figure 3.19); the number of functional feeding groups has remained at six to seven since 2016. Generally, an increase in functional feeding groups within a community is indicative of an increase in habitat quality and overall ecosystem health, reflecting more diversity in primary production and food sources for invertebrates, and more available niches.

Figure 3.16 **Average Simpson's diversity and evenness, scaled to density (#/m²), measured at mid-lake (n=15), littoral (n=15), and near-shore (n=15) areas in Horizon Lake, 2008 to 2018.**



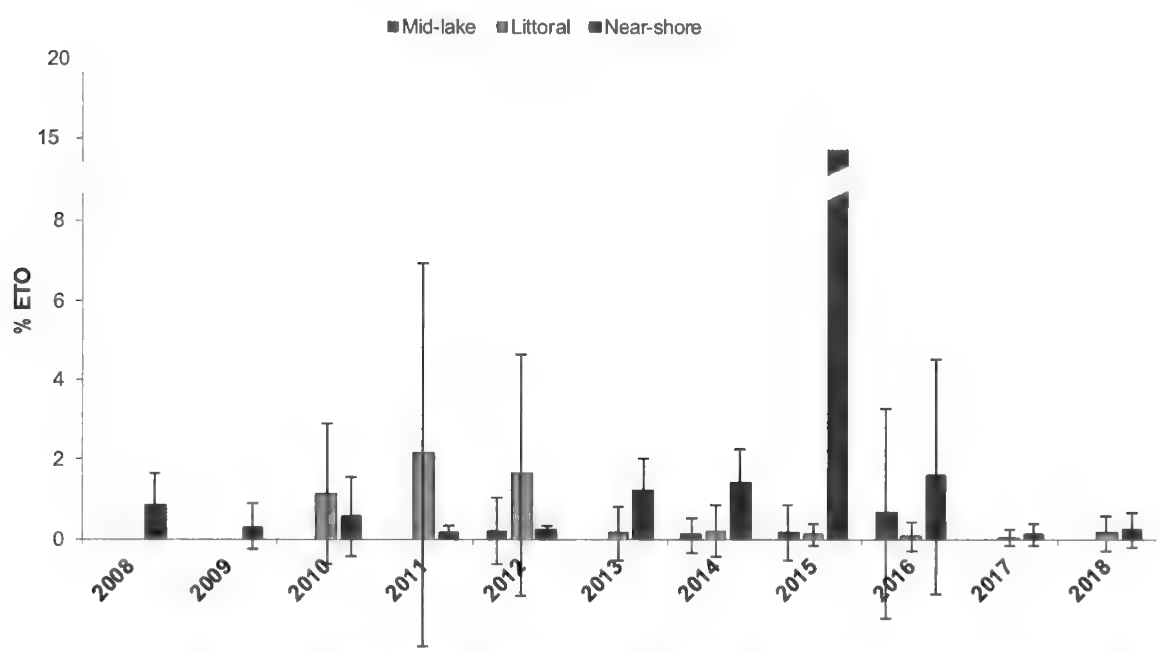
Note: 2008 calculations include two mid-lake sites and one littoral site. 2017 was the first year samples were collected at the near-shore sites using an Ekman grab; therefore, there are no data available for previous years.

Figure 3.17 Pooled species richness (# of families) measured at mid-lake (n=15), littoral (n=15), and near-shore (n=15) areas in Horizon Lake, 2008 to 2018.



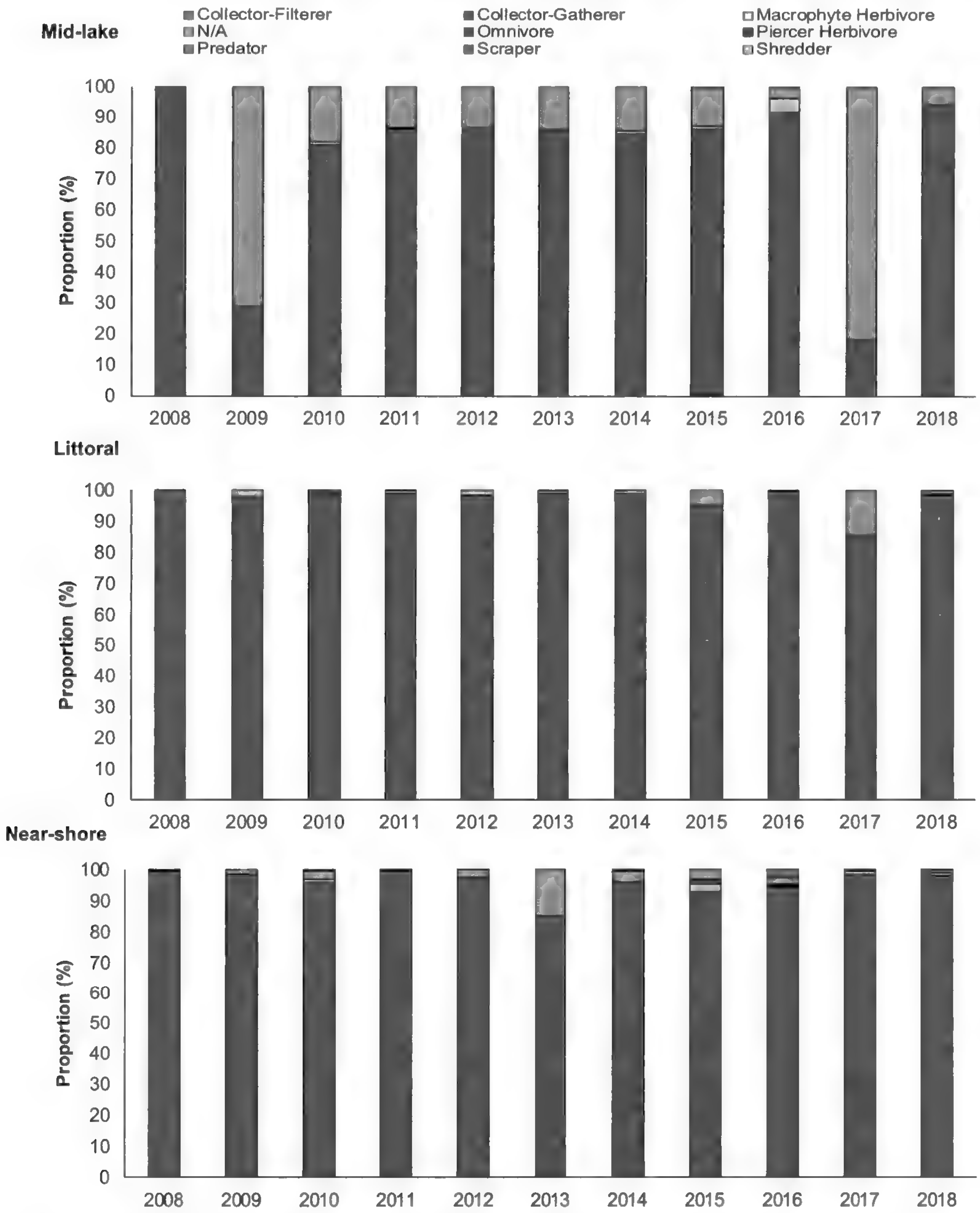
Note: 2008 calculations include two mid-lake sites and one littoral site. 2017 was the first year samples were collected at the near-shore sites using an Ekman grab; therefore, results are not directly comparable to previous years. Counts represent total number of different species collected in each area, pooled from all replicate samples.

Figure 3.18 Average percent ETO measured at mid-lake (n=15), littoral (n=15), and near-shore (n=15) replicate samples from Horizon Lake, 2008 to 2018.



Note: 2008 calculations include two mid-lake sites and one littoral site. 2017 was the first year samples were collected at the near-shore sites using an Ekman grab; therefore, results are not directly comparable to previous years. The high value in 2015 was driven by very large numbers of *Baetidae* mayflies captured in near-shore area replicates.

Figure 3.19 Summary of functional feeding groups at mid-lake (BEN-1 to 3), littoral (BEN-4 to 6), and near-shore (BEN-7 to 9) sites in Horizon Lake, 2008 to 2018.



Note: Sample at BEN-5 was taken at an average depth of 13.8 m in 2017 and therefore analyzed as a mid-lake site; Sample at BEN-1 was taken at an average depth of 2.4 m in 2017 and was therefore analyzed as a littoral site.

N/A: could not be identified to the family level.

3.5 FISH

3.5.1 Tar River Spring Migration

The spring migration monitoring program is undertaken to address three primary objectives, with the overarching goal of characterizing how the upper Tar River contributes to the sustainability of fish populations in Horizon Lake:

- Quantify the number of fish species that utilize the section of the Tar River directly upstream of Horizon Lake during the spring spawning migration;
- Document fish movements in and out of Horizon Lake to better understand seasonal habitat use; and
- Monitor fish growth and fish movements through the deployment and recapture of PIT tags.

A total of 2,084 fish were captured during the spring migration program, consisting primarily of forage fish caught in minnow traps (Table 3.3). Fathead minnow were by far the most abundant species, comprising 92% of the total forage fish captures. The remaining 8% of the forage fish community included lake chub, brook stickleback, slimy sculpin, and a single trout-perch. The 93 large-bodied fish captures consisted of five Arctic grayling and near equal proportions of longnose (n=46) and white sucker (n=47); the majority of these large-bodied fish were captured in fyke nets deployed between May 22 and 24 (Table 3.3). Six of the large-bodied fish were previously tagged (four LNSC and two WHSC; Table 3.7).

CPUE for fyke nets was 8.2 fish/day in 2018, which was within the range of previous years (Table 3.4). CPUE for minnow traps has generally been higher and also more variable than fyke nets, ranging from 0.80 to 74.9 fish/day (Table 3.4). CPUE for minnow traps in 2018 (66 fish/day) was higher than the previous four years but still within the range observed since spring migration monitoring began in 2012 (Table 3.4).

Snorkel surveys were used to visually assess species assemblages, fish distribution, fish abundance, and habitat use in the upper Tar River. A total of 64 habitat units were sampled in spring 2018 (Appendix A4 and Figure 2.3), with fish or spawning indicators observed in 13 of these units (Table 3.5). Observations included: eggs in six of the habitat units; one ripe white sucker in one habitat unit; one fry in one habitat unit; and the presence of juvenile or adult fish in nine of the habitat units, including WHSC in two habitat units, slimy sculpin in three habitat units, fathead minnow in one habitat unit, and trout-perch in one habitat unit. All fish observations were made in run or riffle habitats, with none occurring in the pools. The limited number of observations in 2018 may have been due to the timing of the survey, which occurred from May 29 to June 2, after the spring migration period for Arctic grayling and white sucker and between the bi-modal distribution of upstream trips observed for longnose sucker (discussed in more detail in Section 3.5.1.1).

A Biotactic underwater camera was deployed for the duration of the 2018 spring program to collect supplemental information on fish movement within the upper Tar River; however, the camera was not capable of identifying fish species and movements due to the turbidity of the water and limited field of view of the lens.

The fish capture results for the upper Tar River spring migration program confirmed the presence of eight of the 10 species that have been documented in Horizon Lake; only finescale dace and burbot were not observed, although finescale dance have been captured in the upper Tar River during previous spring sampling programs. Nearly all the captured species are spring spawners (Appendix A13), suggesting they were using the Tar River for spawning. The returns of large-bodied fish that were previously tagged in Horizon Lake also confirms that fish occupying the upper Tar River contribute to the recruitment of the lake populations.

Table 3.3 Number of fish captured in fyke nets and minnow traps in the Tar River, spring 2018.

Species	Gear Type		Total
	Fyke Net	Minnow Trap	
ARGR	5	0	**5**
BRST	0	30	**30**
FTMN	39	1,787	**1,826**
LKCH	25	88	**113**
LNSC	45	1	**46**
SLSC	0	16	**16**
TRPR	0	1	**1**
WHSC	40	7	**47**
Total	**154**	**1,930**	**2,084**

Note: five LNSC were captured twice on May 24 (morning and afternoon) and were only counted as one individual.

Table 3.4 Summary of CPUE (fish/day) for fence boxes, fyke nets, and minnow traps deployed in the lower Tar River, 2012 to 2018.

Gear Type	Year	ARGR	BRST	FNDC	FTMN	LKCH	LNSC	NRDC	SLSC	TRPR	WHSC	Total
Fish Fence	2012	0.74	0.07	0	0.27	20.2	13.7	0	4.61	0	3.07	42.7
	2013	0.47	0	0	0	0	4.85	0	0	0	2.50	7.82
	2014	0	0	0	0	0	0	0	0	0	0	0
	2015	0.03	0	0	0	0	0.14	0	0	0	0.50	0.70
	2016	0	0	0	0	0	0.33	0	0	0	1.47	1.80
	2017	0	0	0	0	0	1.88	0	0.11	0	3.76	5.75
	2018	-	-	-	-	-	-	-	-	-	-	-
Fyke Nets	2013	0.89	0	0	0.13	2.53	0.63	0	0.06	0	2.53	6.77
	2014	0	0	0	0	1.77	0	0	0	0	0	1.77
	2015	0.55	0	0.14	2.67	4.32	0.14	0	0.82	1.37	2.06	12.1
	2016	0	0	0	0	0	0	0	0	0	0	0
	2017	0	0	0	0	0.27	0.40	0	0	0	0.47	1.13
	2018	0.27	0		2.07	1.33	2.39	0	0	0	2.12	8.17
Minnow Traps	2012	0	21.9	0	4.17	0.43	0	0	11.8	0	0	38.3
	2013	0.02	14.4	0.04	50.2	8.10	0	0	1.87	0	0.30	74.9
	2014	0	0.04	0	0	0.64	0	0	0.08	0	0.04	0.80
	2015	0.005	0.50	0.03	7.34	6.24	0.005	0.005	0.36	4.21	0.02	18.7
	2016	0.01	0.10	0	1.84	1.51	0.004	0	0.77	2.53	0	6.78
	2017	0	2.13	0	22.4	1.67	0.22	0.03	1.89	0	0.16	28.5
	2018	0	1.03	0	61.5	3.03	0.03	0	0.55	0.03	0.24	66.4

Note: the fish fence was not operated in 2018.

Table 3.5 Summary of spawning indicators recorded from snorkel surveys on the Tar River, spring 2018.

Habitat Unit	Spawning Indicator(s)	Date	Habitat Type	Wetted width (m)	Max depth (m)	Mean depth (m)	Substrate					
							Organics (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)
HU4	White/Translucent eggs approx. 2mm diameter in cobble.	29-May-18	Run	8-15	0.3	0.2	-	20	20	50	5	5
HU5	Eggs in cobble/gravel	29-May-18	Riffle	6	0.1	0.075	-	-	-	10	90	-
HU6	Eggs in cobble at top of riffle; large egg mass under boulder; 3 WHSC observed (one ripe adult - 250 mm and two juveniles approx. 60 mm).	29-May-18	Run	14	0.5	0.4	Trace	70	-	-	10	20
HU8	1 WHSC (70 mm).	29-May-18	Run	-	0.6	0.3	-	5	5	-	60	30
HU15	1 small (30 mm) unidentified species.	29-May-18	Run	5-8	0.4	0.2	-	-	40	-	35	25
HU19	1 SLSC 60 mm.	29-May-18	Run	6-16	>1.0	0.4	-	-	60	30	10	Trace
HU24	1 unknown species approx. 150 mm.	29-May-18	Riffle	8	0.15	0.1	-	-	-	25	70	5
HU25	1 SLSC 80 mm alive; 1 SLSC mort.	29-May-18	Run	6-18	0.4	0.3	-	-	-	20	80	-
HU31	1 FTMN 40 mm.	31-May-18	Run	10-14	1	0.4	-	-	30	50	15	5
HU33	Fish eggs and 1 fry observed (unidentified species).	31-May-18	Riffle	3-14	0.3	0.2	-	-	10	55	30	5
HU39	Approx. 70 mm unidentified species in debris.	31-May-18	Riffle	12-20	0.2	0.1	-	-	10	20	80	-
HU5	Eggs in shallows at bottom of riffle.	2-Jun-18	-	-	-	-	-	-	-	-	-	-
HU8	Observed SLSC (*n* = 54); SLSC (*n* = 1) with eggs; 1 TRPR.	2-Jun-18	-	-	-	-	-	-	-	-	-	-

HU: Habitat unit

3.5.1.1 Tar River Fish Compensation Habitat Monitoring

Monitoring of the Tar River compensation habitat was completed by Canadian Natural environment staff from 2012 through 2018. The results of this study have been included in this technical report to provide a complete record of all data collections that were undertaken in support of characterizing Horizon Lake in 2018. The results section was written by Canadian Natural's environmental coordinator.

Beaver Activity

Beaver activity was observed in 2013 and mitigation measures were implemented, including placing wire around deciduous trees in the area of the weir and removing the materials deposited by the beaver. In 2017, additional activity was observed and lethal trapping occurred. In 2018, beaver activity was observed within a side channel of the Tar River upstream of the compensation habitat and downstream toward the mouth of the Tar River at Horizon Lake. The locations of partial dams were hand pulled to discourage continued activity in these areas and this mitigation has deterred any rebuild. Additional wire will be place around trees within this area in 2019 and monthly monitoring will continue during open water season until 2021.

Condition of the Rock Weir

In 2018, the cumulative precipitation recorded at the C2 climate station was 330.6 mm (Appendix A2 Figure 5). During 2009, 2015, and 2017 the climate data from C2 data had significant data gaps and therefore these years were removed from the data analysis. The average annual precipitation at C2 was 328.9 mm (Appendix A2 Figure 5). Snow data for 2018 was not available at the time of this report (Appendix A2 Figure 3).

Horizon Lake had a lower than average water level in 2018, with the greatest difference occurring from mid-May to mid-June (Appendix A2 Figure 4). The 2018 lake levels remained above the minimum lake elevation design of 412 meters (Appendix A2 Figure 4).

Daily discharge measured at the S34 Hydrometric Station in 2018 peaked at 4.27 m^3/s during freshet on April 26, with a second notable peak of 2.68 m^3/s in June (Appendix A2 Figure 6). Discharge over the weir can be seen in the April 30, 2018 photo in Appendix A2 Figure 25 at ~2.72 m^3/s. The average discharge from March 1 to November 30 was 0.54 m^3/s in 2018, compared to 0.56 m^3/s from 2009-2017. Overall, 2018 discharge at S34 was lower than the historical average for most of the open water season.

To date, there has been no significant changes to the structural integrity of the weir.

Revegetation

In the summer of 2012 and 2013, the area around the weir that was disturbed by construction was seeded with a mixture of native grasses. White spruce (*Picea glauca*) and black spruce (*Picea mariana*) were planted in the summer of 2016 in this area. Additionally, ingress of native vegetation has occurred within the disturbed site. Photographs of the vegetation regrowth are provided in Appendix A2 Figures 20 to 23.

Overwintering Habitat

The midstream location has had the most consistent water depths and ice thickness (Appendix A2 Figure 8).

The left bank ice thickness and water depth has been thinner and shallower in recent years, while the right bank has had thicker ice and deeper water. This is due to the sedimentation below the weir, with the majority of the flow through the center and right bank of the river. The thalweg has shifted from left bank to the right bank since 2014 (Appendix A2 Figure 7 and Figure 9). The center of the constructed habitat continues to have the deepest pool and provides overwintering habitat.

Decreased flows during the fall cause sedimentation accumulation below the weir during the winter with annually flushing of the pools during the spring freshet. A photo of the left, center, and right monitoring locations in relation to the weir in the winter can be seen in Appendix A2 Figure 24.

Water Quality

Temperature data collected from the data sonde indicated that overall 2018 had an average temperature during open water season that was comparable to historical data (Appendix A2 Figure 10); however, the fall was colder than average and ice was observed forming in still water areas as early as September 20. Arctic grayling are reported to be stressed in waters above 17.2˚C degrees, and have an upper incipient lethal temperature for water between 23-25˚C (Alberta Environment and Parks and Alberta Conservation Association., 2015). In 2018, there were five days which had average temperature in the constructed habitat above 17.2 ˚C, and no days in 2018 were observed above 23 ˚C. A comparison of the daily temperature recorded at S34 Hydrometric Station to the threshold values for Arctic grayling are presented in Appendix A2 Figure 11 and Figure 12.

pH in 2018 was within the historical ranges observed in the regional monitoring programs from 8.33 to 7.92. In 2016, the pH is seen to be have a constant elevated level compared to other monitoring years (Appendix A2 Figure 13), and it is suspected to be attributed to calibration error prior to deployment of the data sonde. DO remained above 9.0 mg/L (greater than 90% saturated) the majority of the summer (Appendix A2 Figure 14). Specific conductivity has shown to follow a trend throughout the monitoring period; spring freshets end is shown with a steep drop in conductivity, followed by a progressive increase over the open water season (Appendix A2 Figure 15). 2018 was no exception, and followed this trend during the monitoring period.

Velocity and Depth

Overall, 2018 was below average historical values for velocity and depth. Average depth and velocity during open water season ranged from 0.136-0.379 meters and 0.179-0.414 m/s, respectively. Point measurement depths ranged from 0.02-0.80 meters and velocity from 0.001-1.186 m/s. Velocity and depth average values can be seen in Appendix A2 Figure 16 and Figure 17.

Arctic grayling spawning is recorded to occur in waters between 0.5 and 1.0 m/s (Alberta Environment and Parks and Alberta Conservation Association., 2015), which is within the range since in the Tar River during the 2018 monitor program.

Habitat Mapping

Area and proportions of habitat types and changes can be seen in Appendix A2 Table 2.

Comparison between the natural variations in habitat type by area can be seen in Appendix A2 Table 3.

Changes in habitat have been observed since the creation of the first map in 2013. The rock weir has been stable since it was built but there have been changes in the habitat surrounding the rock weir. In 2018, approximately one third of the woody debris in the pool located ~60 meters downstream from the weir had washed away during the spring freshet. In 2018, the small side channel on the west side of the 85-meter downstream island became the main pathway for the river after the freshet scoured the bank on the west and deposited more gravels onto the riffle located on the eastern side. Please see habitat changes in Appendix A2 Table 2 for further details on habitat change.

Fish Use

2018

A total of 2,985 fish were captured during the 2018 fish compensation habitat monitoring on the upper Tar River (Appendix A2 Table 3). The largest number of fish were observed upstream of the enhancement habitat (n = 2,254), followed by downstream (n = 369), and within it (n = 17); however, these abundance numbers are skewed by the higher intensity of sampling effort that occurred upstream of the enhancement habitat (Appendix A2 Table 4), and consequently the seasonal comparisons in the following sections are standardized to CPUE. An additional 345 fish were captured at unknown locations during the 2018 sampling programs (Appendix A2 Table 3).

Richness ranged from four to eight species, with the lowest value observed in the enhancement habitat and the highest value observed upstream of the habitat. Overall, a total of nine species were captured in 2018, consisting of Arctic grayling, brook stickleback, fathead minnow, lake chub, longnose sucker, pearl dace, slimy sculpin, trout-perch, and white sucker.

Fathead minnow, lake chub, and slimy sculpin were the only species captured at all three sampling areas in 2018. Species composition at all three areas were predominantly forage fish, with the dominant species consisting of trout-perch downstream (53%), lake chub within (59%), and fathead minnow upstream (81%) of the enhancement habitat.

Seasonal Comparisons – 2015 and 2018

Spring

Fyke netting and minnow trapping were the only two methods used in both spring 2015 and 2018.

Fyke netting CPUE downstream of the enhancement habitat (0.90 fish/hour) was higher than upstream (0.19 fish/hour) in 2015, while no sampling was conducted within the habitat (Appendix A2 Table 5). In 2018, fyke nets were only deployed upstream of the enhancement habitat and resulted in a CPUE of 0.38 fish/hr. Overall the CPUE for fyke nets in 2015 was slightly higher than 2018 (0.48 vs. 0.38 fish/hour, respectively).

In 2015, minnow trapping CPUE was highest within the enhancement habitat (0.99 fish/hour), while downstream was intermediate (0.93 fish/hour) and upstream was lowest (0.51 fish/hour). Like fyke nets, minnow trapping was only conducted above the habitat in 2018. Minnow trapping CPUE in 2015 was lower than 2018 (0.76 vs. 3.62 fish/hour, respectively) (Appendix A2 Table 5).

Summer

Electrofishing was the only fishing method employed in the summers of 2015 and 2018; however, electrofishing in 2018 was not separated by location in all sampling events (i.e., downstream, within, or upstream of the enhancement habitat) so comparisons cannot be made among locations (Appendix A2 Table 5). In 2015, CPUE downstream of the enhancement habitat (2.79 fish/100 secs) was higher than upstream (1.12 fish/100 secs), while no electrofishing was completed within the enhancement habitat.

Fall

Fyke nets were deployed downstream and upstream of the enhancement habitat in fall 2015 and 2018. Downstream CPUE was higher than upstream in 2015 while the opposite was true in 2018 (Appendix A2 Table 5). Fall CPUE for fyke netting conducted in 2015 was higher than 2018 (10.2 vs. 3.98 fish/hour, respectively).

ARCTIC GRAYLING CAPTURES – 2015 AND 2018

A total of 33 Arctic grayling were captured on the upper Tar River, consisting of 28 captures in 2015 and five in 2018 (Appendix A2 Table 7); most of these fish were captured in fyke nets (n = 31).

Arctic grayling were captured upstream (n = 1) and downstream (n = 9) of the enhancement habitat in 2015, and upstream of the enhancement habitat in 2018 (n = 4) (Table 4). There was only one grayling captured in summer, which occurred upstream of the habitat in 2018. Similarly, grayling have only been captured in one location in fall, downstream of the enhancement habitat in 2015 (n = 18). Overall, grayling were most abundant downstream the habitat, while none were captured within the habitat in either year.

3.5.1.2 PIT Tagging

All burbot, white sucker, and longnose sucker greater than 130 mm and all Arctic grayling greater than 75 mm in length received PIT tags during the upper Tar River and Horizon Lake fish sampling programs, with additional tagging effort undertaken by Canadian Natural throughout the year. The PIT tagging objectives were to provide supplemental information to characterize fish use of the Tar River during the spawning season, remotely monitor fish movement patterns (conducted by Canadian Natural using an automated PIT tag antennae in the Tar River), and provide information on individual fish growth and a relative measure of species abundance in Horizon Lake. All fish capture data are provided in Appendix A4.

151 fish were implanted with PIT tags in 2018, including 23 Arctic grayling, 59 longnose sucker, and 69 white sucker (Table 3.6). Cumulatively, 4,136 fish have been implanted with PIT tags since the initiation of the Program in 2008 (Table 3.6).

Four longnose sucker and three white sucker previously implanted with PIT tags were recaptured in 2018, with deployment of the tags occurring between October 2011 and June 2017 (Table 3.7). Of the seven recaptures, three fish (two longnose and one white sucker) were initially tagged and recaptured in the Tar River, two longnose sucker were initially tagged in Horizon Lake and recaptured in Tar River, and no initial capture data were available for the remaining two white sucker.

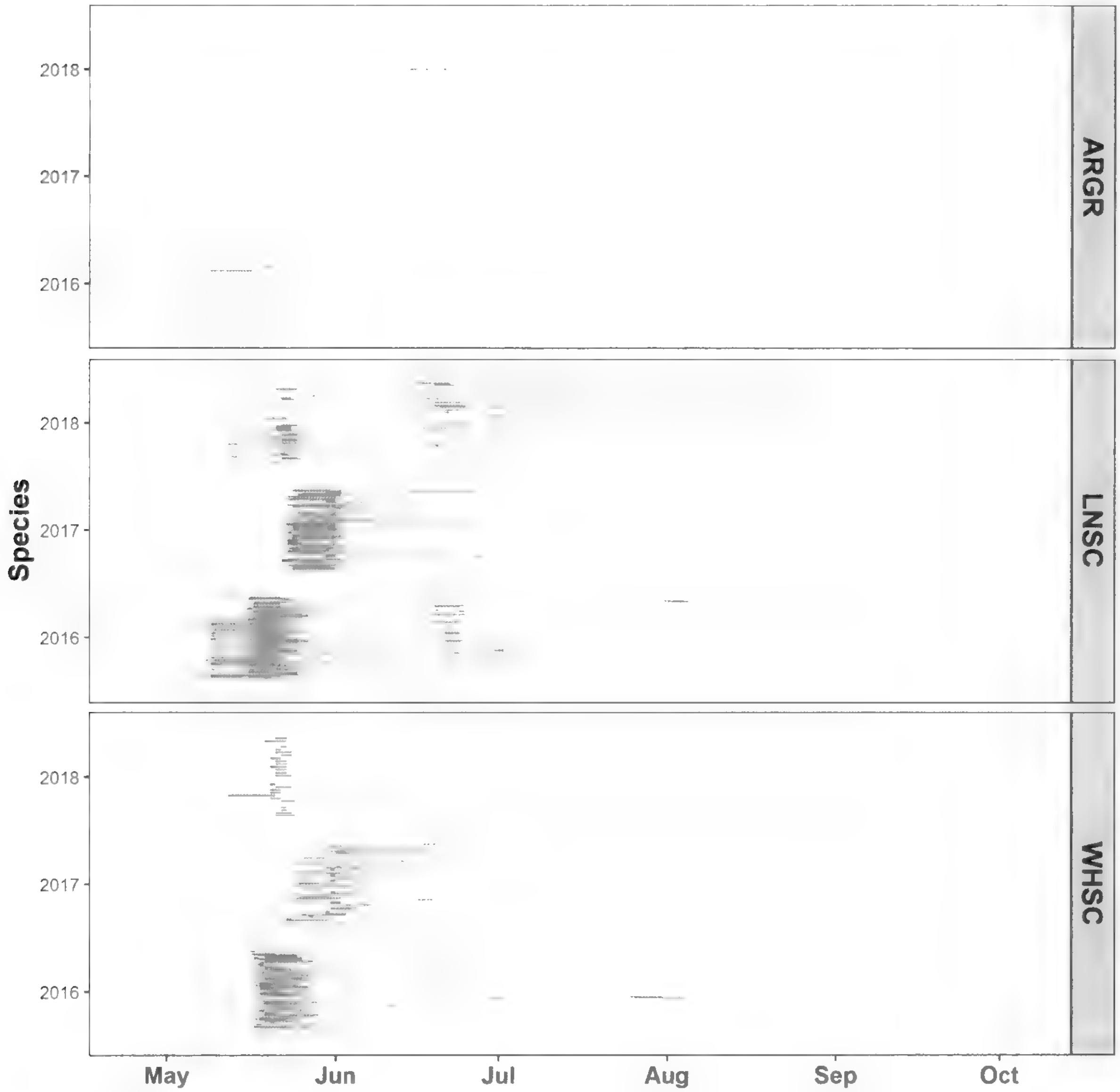
The PIT antenna system has detected 1,274 of the 4,136 tags in the tag database (31%) since the installation of the first antenna array in 2013. The number of observations per year has varied, particularly since the installation of the upstream antenna in August 2015. Discussion in this report is focused on the 2016 to 2018 results, primarily because the two-array system provides information on the direction of fish movement.

The shortest residence times upstream of the two antennae were much less than a day in duration, and likely represented short passes to the upstream array followed by returns to the lower sections of the river or the lake. Most upstream residence durations were one week or less (Figure 3.20).

The timing of upstream residence varies among species and among years (Figure 3.20). Generally, the first upstream movements for Arctic grayling, longnose sucker, and white sucker were all observed in early May. The timing of first upstream movement and the peak of upstream movement was substantially delayed in 2017, and moderately later in 2018 relative to 2016. Individual white sucker tended to have substantially shorter residence durations in the spring of 2018, whereas the timing and duration of upstream residences of the other two species were more consistent across years. All three species also show upstream movement throughout the summer, although most upstream movements were observed prior to the end of June. Longnose sucker were observed to have the longest and most frequent upstream durations in summer 2018, relative to other species and to previous years. In addition, a bi-modal distribution of upstream trips may be evident for longnose suckers. Arctic grayling also exhibited extended upstream residence times, although the number of records was limited.

Over the past three years, there has been a substantial movement of fish in the spring. Based on life-histories of these fish (Appendix A13) and observations from the fish fence program in previous years (Hatfield 2016, 2017, and 2018), these movements can confidently be classified as spring spawning migrations, which confirms that Tar River provides suitable spawning habitat for resident fish and contributes to the recruitment of fish to Horizon Lake.

Figure 3.20 Timing and duration of upstream residence of individual Arctic grayling (ARGR), longnose sucker (LNSC), and white sucker (WHSC), 2016 to 2018.



Fish residing upstream longer than 10 days are marked in orange.

Table 3.6 Fish tagging results for Horizon Lake and Tar River, 2008 to 2018.

Year	Season	Species							
		ARGR		BURB		LNSC		WHSC	
		Tagged	Recaptured	Tagged	Recaptured	Tagged	Recaptured	Tagged	Recaptured
2008	Spring	0	0	0	0	2	0	0	0
2009	Spring	0	0	0	0	24	0	0	0
	Summer	0	0	0	0	2	0	0	0
2010	Spring	0	0	0	0	25	0	67	0
	Summer	0	0	5	0	45	0	119	0
	Fall	2	0	0	0	61	0	40	0
2011	Spring	0	0	0	0	49	0	97	0
	Summer	0	0	0	0	44	0	90	1
	Fall	2	0	0	0	100	3	41	1
2012	Spring	10	1	0	0	248	9	153	0
	Summer	0	0	0	0	238	17	328	4
	Fall	1	0	0	0	10	0	45	1
2013	Spring	7	1	0	0	248	17	223	8
	Summer	0	0	0	0	0	0	4	0
	Fall	23	0	0	0	35	7	141	4
2014	Fall	3	1	0	0	55	7	11	0
2015[a]	Spring	3	0	0	0	4	0	34	3
	Summer	0	0	0	0	173	0	0	0
	Fall	28	0	0	0	204	17	318	3
2016	Spring	3	0	0	0	4	0	16	1
	Summer	0	0	0	0	10	1	0	0
	Fall	3	0	0	0	135	7	139	1
2017	Spring	1	0	0	0	25	5	40	6
	Summer	0	0	0	0	94	0	47	1
	Fall	4	0	0	0	62	6	39	3
2018	Spring	2	0	0	0	41	4	34	2
	Summer	0	0	0	0	15	0	13	0
	Fall	21	0	0	0	3	0	23	1
Total		**113**	**3**	**5**	**0**	**1,956**	**100**	**2,062**	**40**

[a] An additional two LNSC were recaptured by Canadian Natural in 2015. One of these recaptures was identified as a LNSC on 4-Aug-15 but identified as a WHSC when it received a tag on 28-May-13.

Table 3.7 History of fish recaptured in 2018.

Tag #	Species	Capture / Recapture	Date	Site	Length (mm)	Age
985121017901035	WHSC	Capture		No previous record of fish		
		Recapture	22-May-18	Tar River	415	9
985120028265344	LNSC	Capture	6-Oct-11	Horizon Lake	292	
		Recapture	22-May-18	Tar River	357	-
989001004739191	WHSC	Capture	1-Jun-17	Tar River	321	-
		Recapture	23-May-18	Tar River	350	-
900236000186484	LNSC	Capture	29-May-13	Tar River	314	-
		Recapture	23-May-18	Tar River	335	-
900236000186825	LNSC	Capture	30-May-13	Tar River	313	-
		Recapture	23-May-18	Tar River	325	-
989001001689262	LNSC	Capture	19-Oct-15	Horizon Lake	275	-
		Recapture	23-May-18	Tar River	283	5
900118001421834	WHSC	Capture		No record of initial capture		
		Recapture	31-May-16	Tar River	395	-
		Recapture	5-Oct-18	Horizon Lake	422	-

LNSC: longnose sucker; WHSC: white sucker.

3.5.2 Fish Health

The average condition factor of Arctic grayling, fathead minnow, lake chub, and longnose and white sucker captured during fall sampling of Horizon Lake have generally remained between 1.0 and 1.2 since monitoring was initiated in 2008 (Figure 3.21). This is the same range observed for these species during the Fish Assemblage Monitoring Program that was annually implemented from 2009 to 2016, which assessed fish communities in streams and rivers of the oil sands region (www.ramp-alberta.org). No directional patterns in fish condition between years have been observed, and the 2018 condition factor estimates were within the range of historical observations.

Based on external observations, approximately 5% of fish captured during the 2018 fall sampling program showed evidence of parasite presence, which was within the range of the past two years (4% in 2017 and 7% in 2016). Lake chub and white sucker were the only species that showed evidence of parasites in 2018. Parasites were not sent for identification in 2018, but skin parasites collected from white sucker in the fall of 2016 were identified as leeches (*Hirudinea* belonging to the family *Piscicolidae*), while the internal parasites were identified as tapeworms from the order *Pseudophyllidea* and plerocercoid larvae (the larval stage of many cestodes). Plerocercoid are common in freshwater fish in Alberta and are associated with the swollen or bloated stomachs that were observed in a small portion of fish captured from Horizon Lake (AESRD 2004; GoA 2014). There are several genera of tapeworms (e.g. *Triaenophorus, Schistocephalus, Ligula*) that are listed as common parasites in Alberta (GoA 2014). Parasite-affected fish are more easily predated because their bigger belly makes them fatter, slower, and less maneuverable; they also spend more time at the surface of the water due to increased oxygen demand (GoA 2014).

Concentrations of total mercury, methyl mercury, total metals, and organics in fish tissues collected from Horizon Lake in 2018 were compared to available guidelines (outlined in Table 2.9 and Table 2.10), data from previous years, and samples collected from the reference watershed (Calumet Lake and Calumet River).

Figure 3.21 Condition factor of FTMN, LKCH, LNSC, and WHSC captured from Horizon Lake during fall sampling, 2009 to 2018.

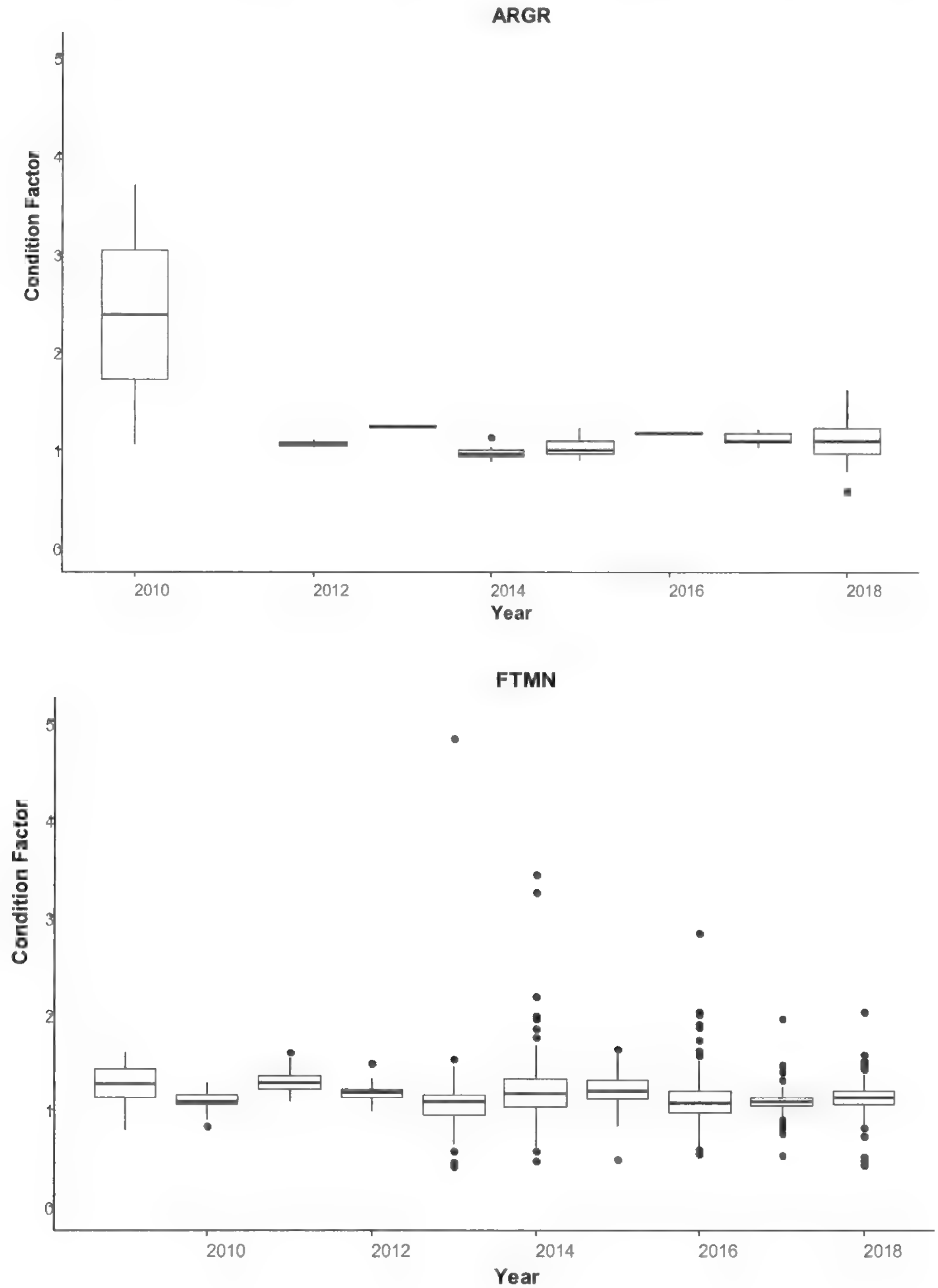
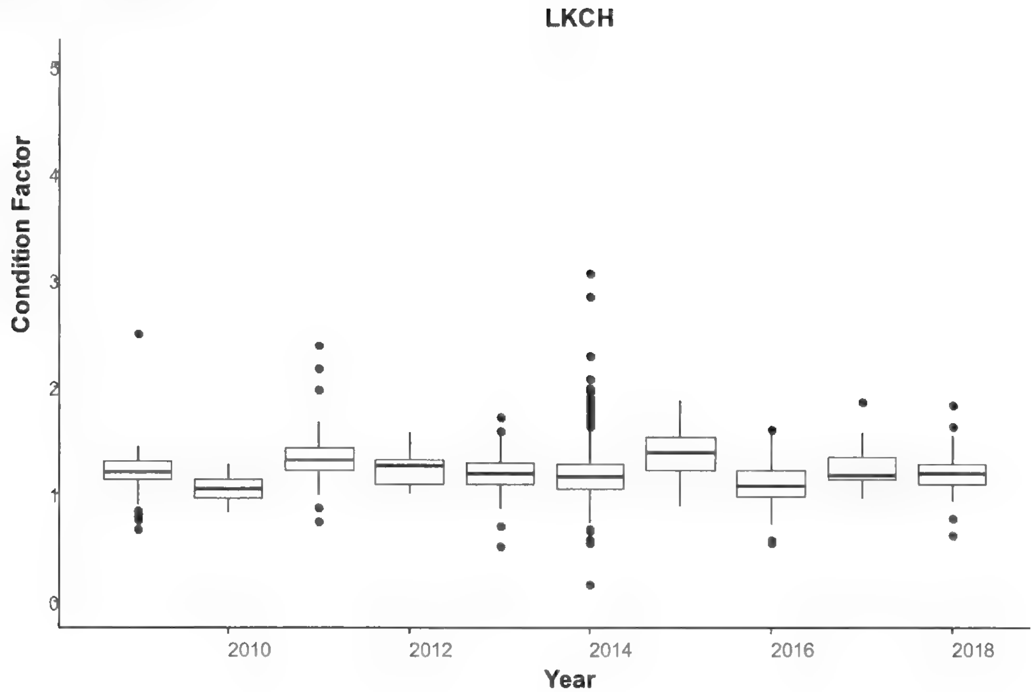


Figure 3.21 (Cont'd.)



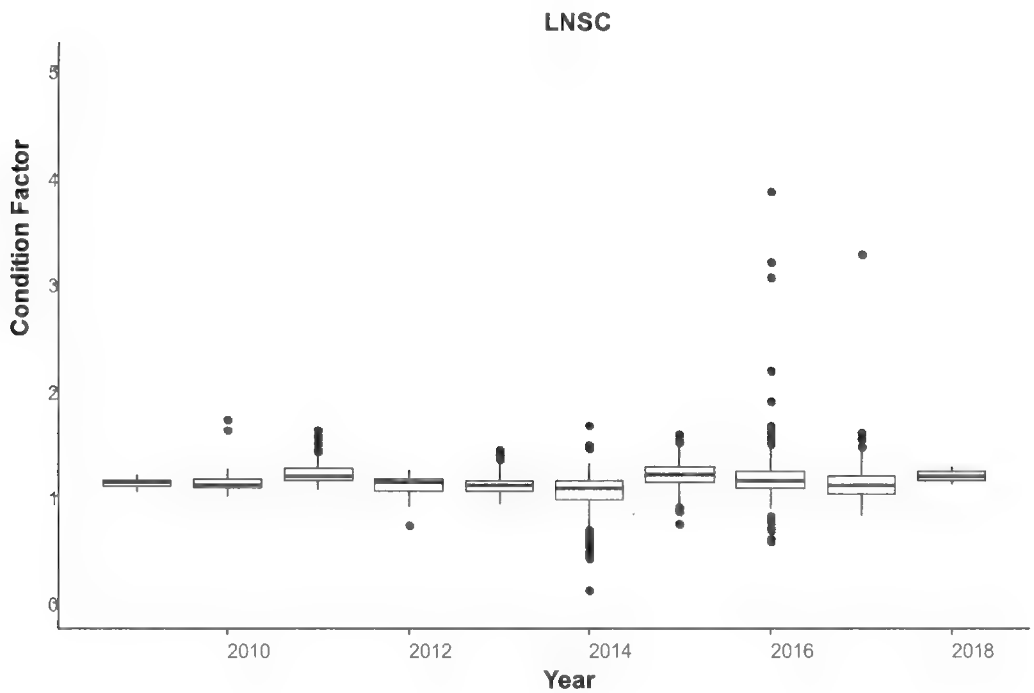
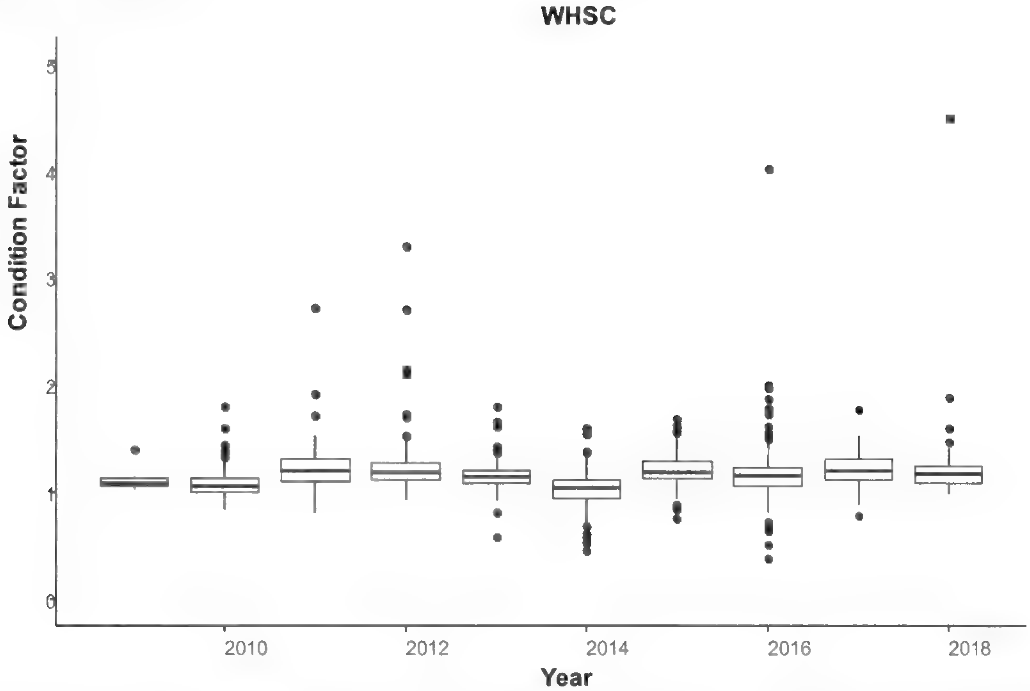


Figure 3.21 (Cont'd.)



Boxes indicate 50% of data (25%-75%) separated by the median value; bars extend to 5th and 95th percentile; dots represent values outside of the 5th-95th quantile range.

3.5.2.1 Mercury

Composite Tissue Samples

Mercury concentrations in whole-body composite samples were highest in 2010 and 2011, followed by a downward trend from 2012 to 2017 (Figure 3.22 to Figure 3.24), with the exception of an increase in mercury concentrations in juvenile WHSC in 2015, which was the result of the 90 to 120 mm target length bin not being filled and larger fish (180 to 191 mm) being analyzed in their place. Mercury concentrations in FTMN and LKCH composites collected from Horizon Lake in 2018 increased slightly from 2017 but were within the historical range (2009 to 2017), while concentrations in juvenile WHSC were lower than all previous years and lower than Calumet watershed fish in 2018. The initial increase and subsequent tail-out of mercury concentrations was an expected result of the back-flooding that occurred when the lake was constructed in 2008, which caused the organic carbon in soils and plant materials to decompose, leading to the release of mercury stored within soils and vegetation, which then became available for methylation by microbial activity (Jackson 1988; Kelly et al. 1997; St Louis et al. 2004). While different species and sizes of fish have variable accumulation rates, an increase in fish tissue mercury concentrations has been previously observed in reservoirs, generally occurring within the first two years after flooding (Jackson 1991; Kelly et al. 1997; Bodaly and Fudge 1999). Mercury concentrations in fish tissues often decline following reservoir back-flooding, with the duration and the rate of decrease dependent on several factors, including fish species (Bodaly et al 1984; Jackson 1991; Bodaly et al 2007). For example, Bodaly et al (2007) measured total mercury concentrations in three fish species collected from 14 impounded lakes and lake basins in northern Manitoba and found that concentrations in northern pike and walleye (*Sander vitreus*) were highest 2-8 years after lake impoundment and took 10-23 years to return to background levels, while concentrations in lake whitefish (*Coregonus clupeaformis*) typically peaked within six years after impoundment and took 10 to 20 years to return to background levels. Concentrations since 2015 appear to have reached a relatively steady state in Horizon Lake, with minor natural fluctuations occurring from year-to-year in response to environmental conditions.

Concentrations of mercury in lake chub were noticeably higher than fathead minnow prior to 2015 (Figure 3.22 and Figure 3.23). This may be a result of the longer life expectancy of lake chub (5 versus 2 years; Scott and Crossman 1973) coupled with differences in diet that may cause lake chub to bio-accumulate mercury more rapidly. The short life-span of fathead minnow results in relatively fast population replenishment, which replaced fish that were exposed to the conditions of peak methylation. Both species showed the same general response pattern to backflooding, although the fathead minnow was more muted for the reasons stated above.

Total mercury concentrations in fathead minnow, lake chub, and juvenile white sucker whole-body composites have not exceeded Health Canada, USEPA, or Region III USEPA tissue guidelines (outlined in Table 2.9) since monitoring commenced in 2011. Concentrations of mercury in whole-body composites from Horizon Lake were consistently higher than the Calumet reference watershed from 2011 to 2015, but have been similar or lower from 2016 through 2018.

Figure 3.22 Total and methyl mercury in composite tissue samples of fathead minnow from Horizon Lake and the Calumet watershed, 2009 to 2018.

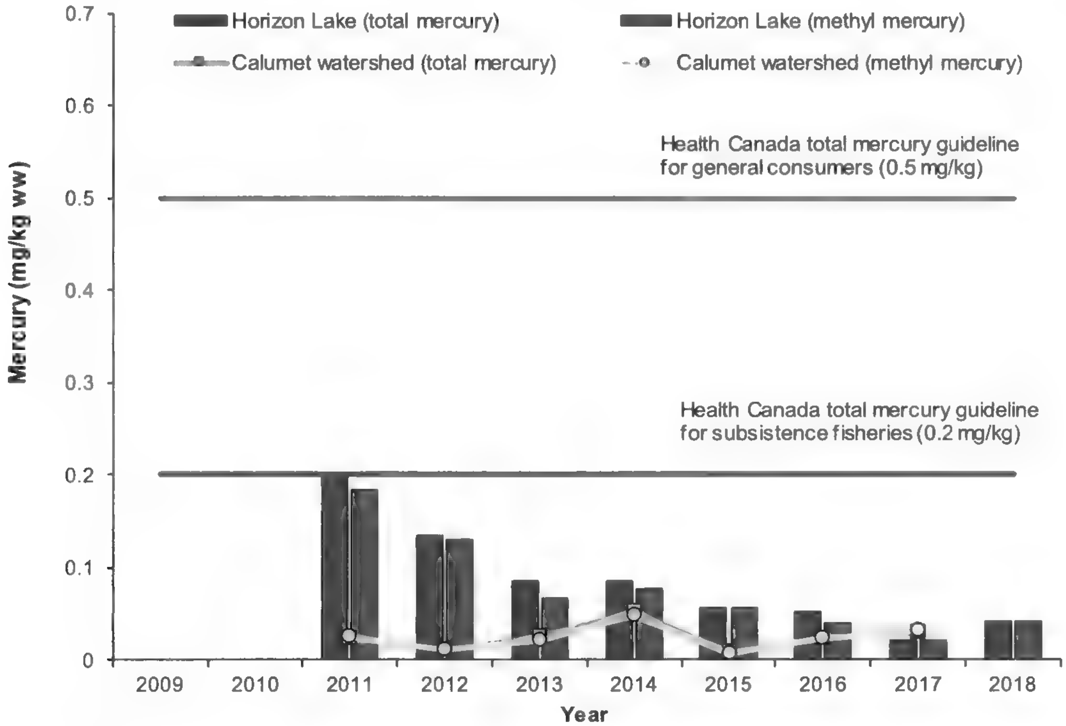
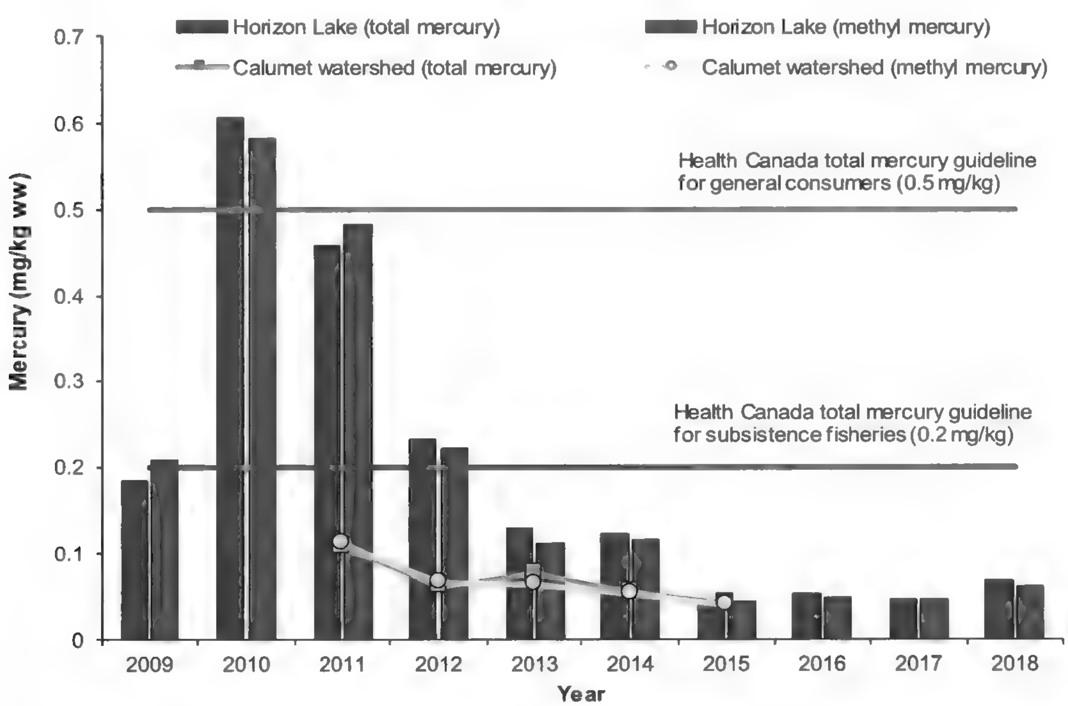
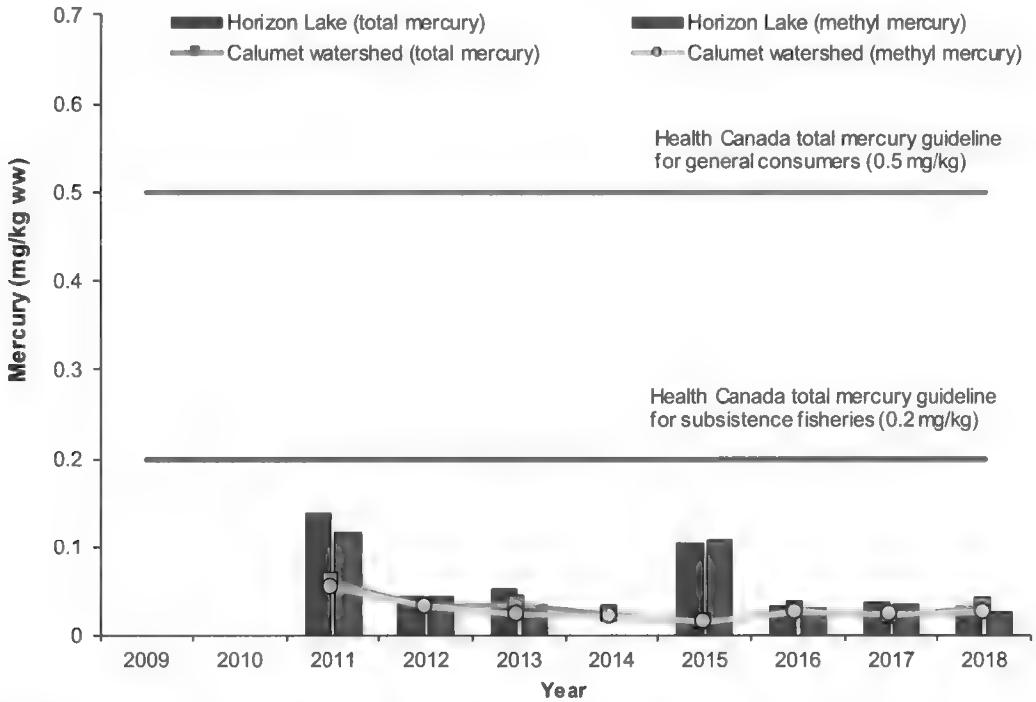


Figure 3.23 Total and methyl mercury in composite tissue samples of lake chub from Horizon Lake and Calumet watershed, 2009 to 2018.



Note: 2011 represents the first year that fish were sampled from the Calumet watershed.

Figure 3.24 **Total and methyl mercury in composite tissue samples of juvenile white sucker from Horizon Lake and Calumet watershed, 2009 to 2018.**



Note: insufficient sample numbers were collected from Horizon Lake for mercury analysis in 2014 (Golder 2015).

White Sucker (Tissue Plug Samples)

Total mercury in adult WHSC captured from Horizon Lake in 2018 ranged from 0.080 to 0.17 mg/kg (Figure 3.25), while methyl mercury concentrations ranged from 0.068 to 0.14 mg/kg (Figure 3.26). Median concentrations of both total and methyl mercury in 2018 were lower than all previous years (Figure 3.25 and Figure 3.26).

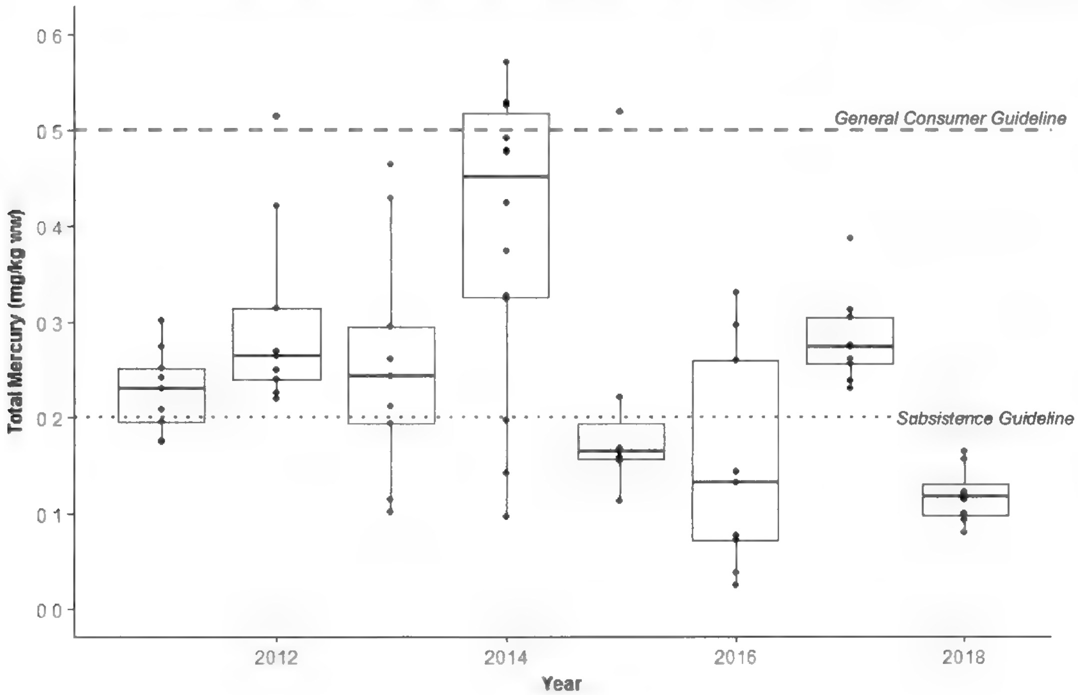
2018 was the first year that total mercury concentrations in adult white sucker tissue samples were all below the 0.2 mg/kg Health Canada (2007a) guideline for subsistence fisheries. 46 WHSC (62% of all fish tested) have exceeded the mercury guideline for subsistence fisheries, while six (8%) have exceeded the mercury concentration guideline for general consumers since fish tissue monitoring was initiated in 2011.

Length normalized mercury concentrations were calculated to facilitate comparisons of the annual loadings in Horizon Lake fish. This qualitative approach was taken because assumptions of equal variances were not met to run an ANCOVA. Length-normalized data show a declining trend in total and methyl mercury loadings over time, with the exception of 2014 and 2017, which both showed year-on-year increases (Figure 3.25 and Figure 3.26). The increases observed in 2014 and 2017 may be because older fish were collected in these years, with fish collected in 2017 aged 5+, while ages of fish collected in 2016 ranged from 2 to 6 years old (Figure 3.27); however, there are no age data available for fish collected in 2013 and 2014.

Mercury concentrations in fish typically increase with age, as they feed and bioaccumulate mercury in their tissues. The accumulation of mercury in fish tissues can be assessed by analyzing the mercury concentration

in each age-class across the cohorts of fish (i.e., the year of birth). Mercury is naturally excreted by organisms, so observed accumulation of mercury in tissues is the result of mercury intake minus mercury excretion. Figure 3.27 shows the tissue mercury concentrations for each fish presented by age. As expected, total and methyl mercury concentrations both show a positive correlation to increasing age (Figure 3.27).

Figure 3.25 Total mercury and length-normalized total mercury in adult white sucker captured from Horizon Lake, 2011 to 2018.



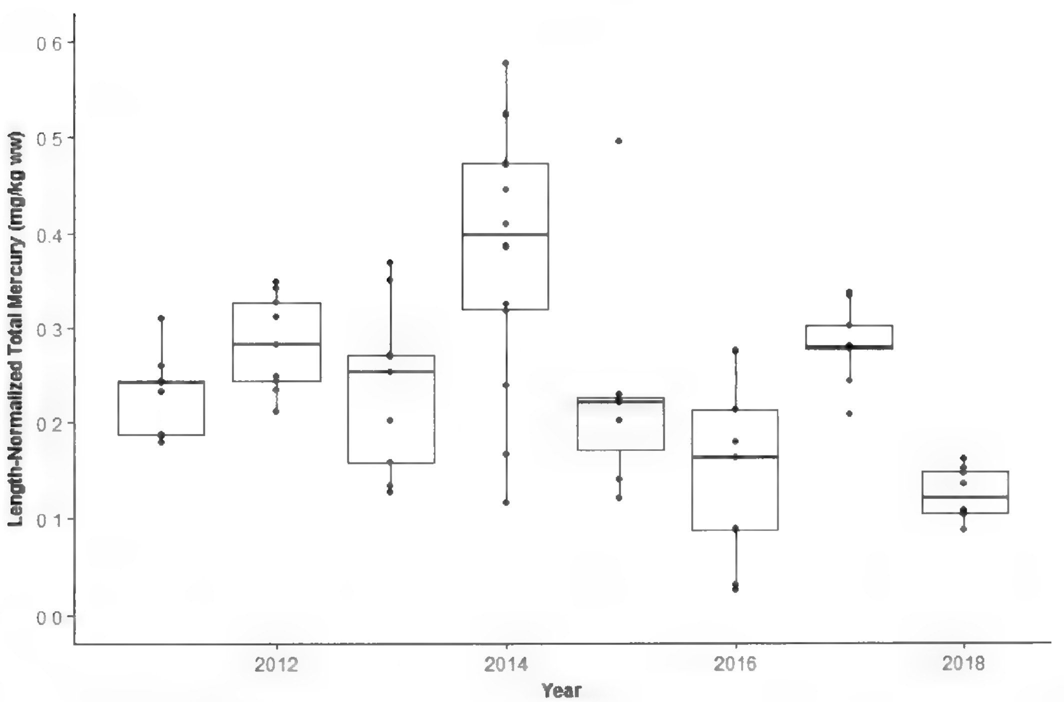


Figure 3.26 Methyl mercury and length-normalized methyl mercury concentrations in adult white sucker captured from Horizon Lake, 2011 to 2018.

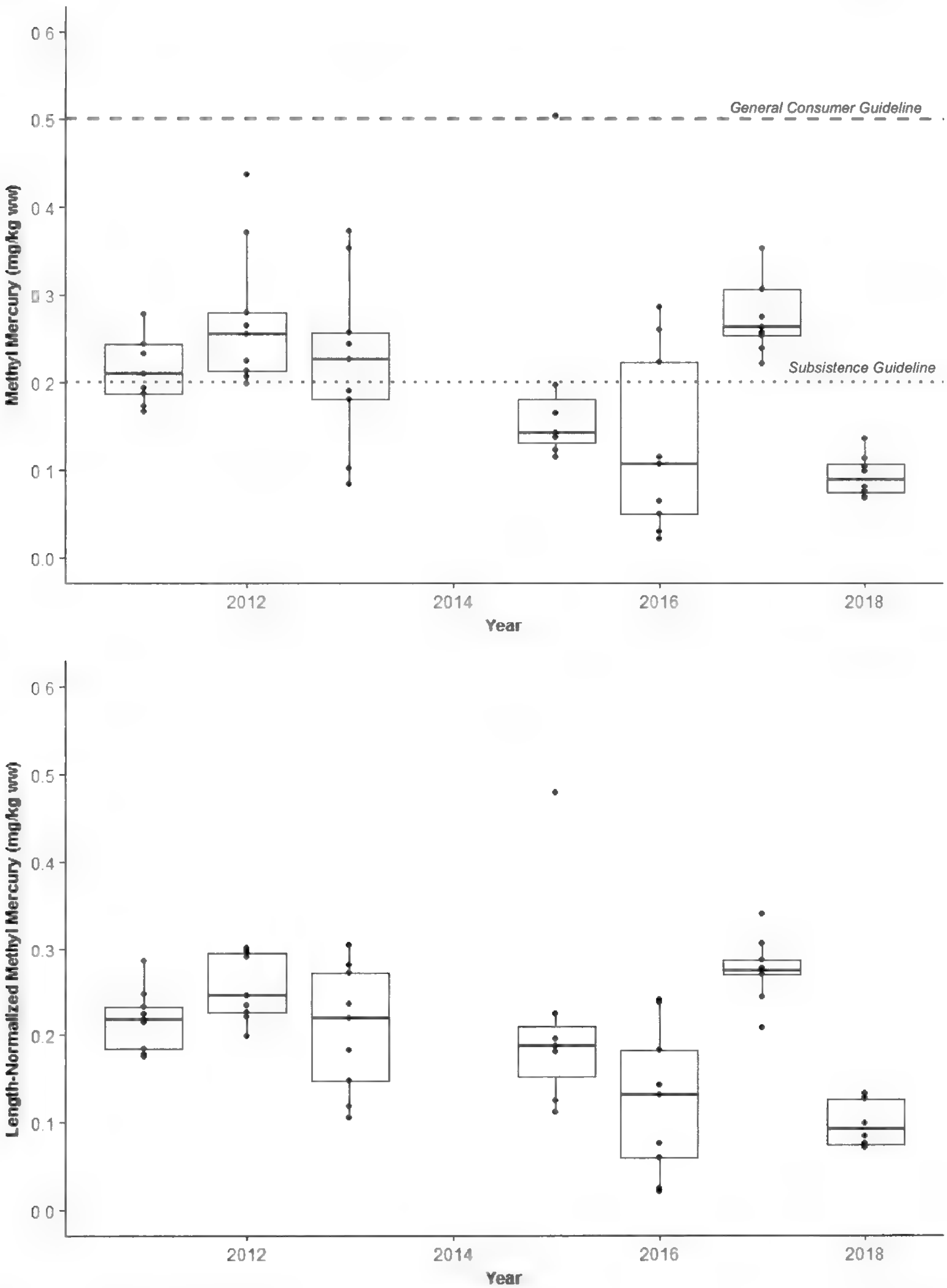
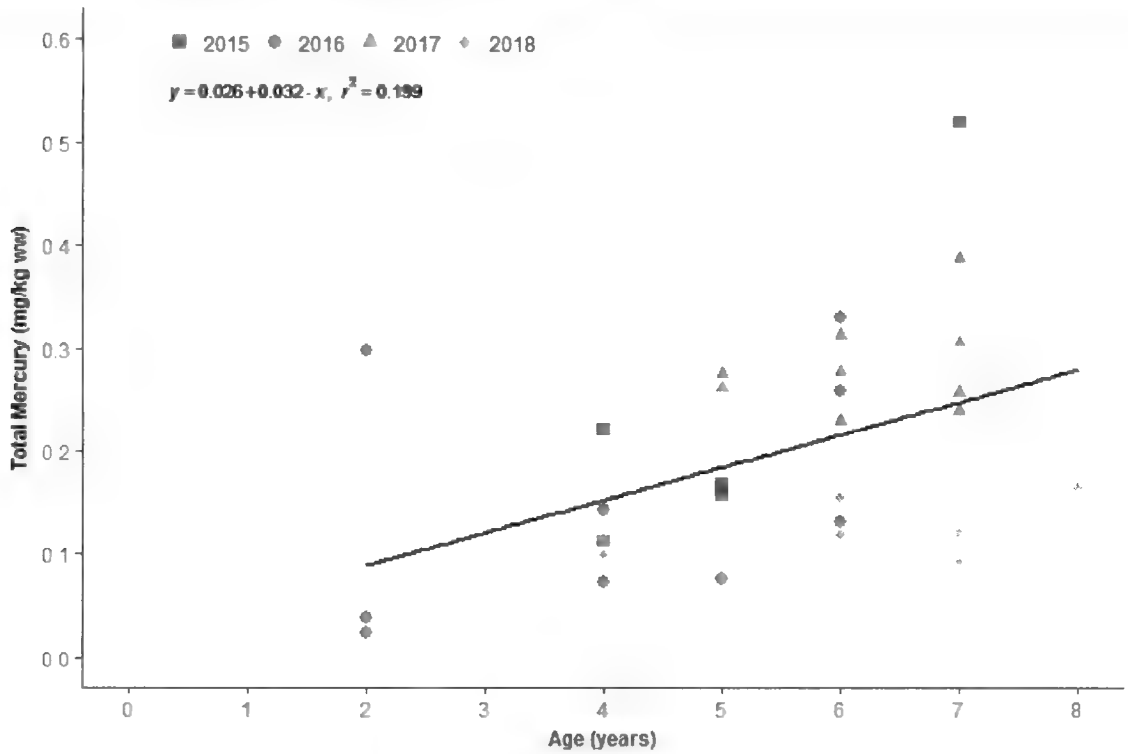
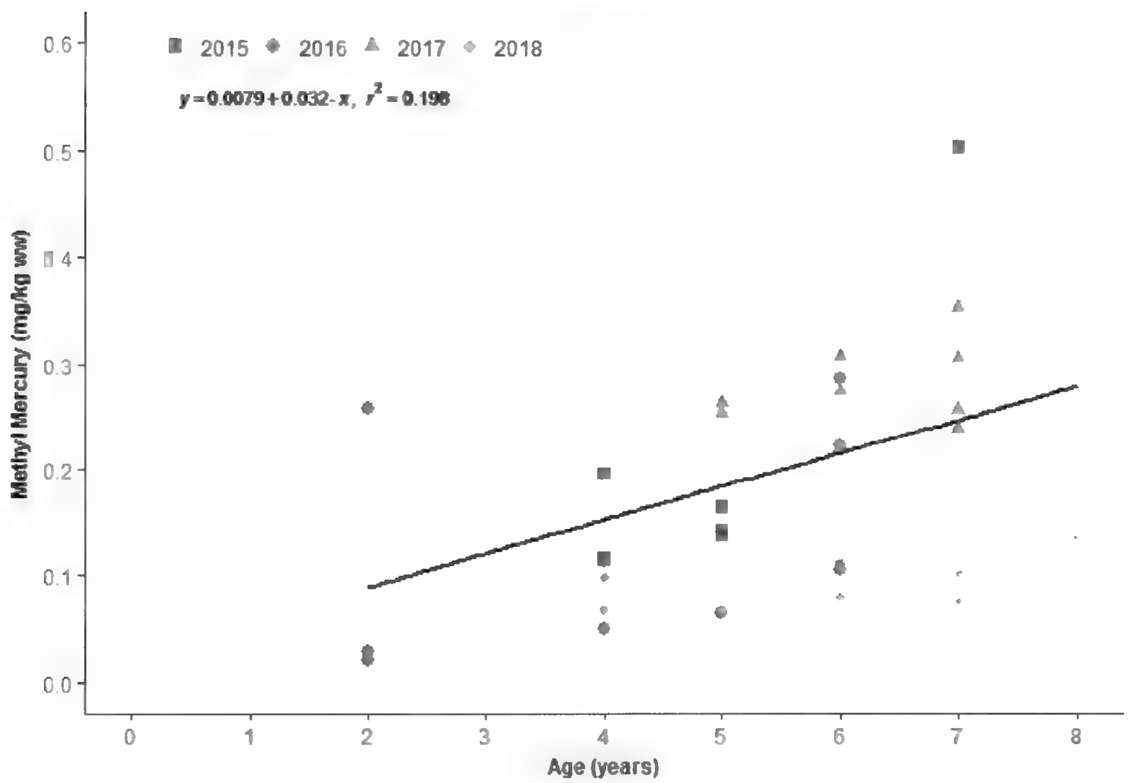


Figure 3.27 Total mercury and methyl mercury (by age) in white sucker captured from Horizon Lake, 2015 to 2018.





Note: there are no age data available from 2011 to 2014; *n* = 6 in 2015; *n* = 9 in 2016; *n* = 9 in 2017; and *n* = 8 in 2018.

3.5.2.2 Metals and Organics

Concentrations of most of the metals measured in fish tissues from Horizon Lake and the Calumet watershed were below human health consumption guidelines in 2018 (Appendix A4), with the exception of arsenic, chromium, and mercury (Table 3.8), which were found to be above the National USEPA and/or Region III USEPA guidelines (see Table 2.9 for guidelines); concentrations of arsenic and chromium exceeded in all samples collected from Horizon Lake and the Calumet watershed, while mercury exceeded in all adult white sucker and the lake chub composite from Horizon Lake.

Concentrations of aluminum, copper, selenium, and vanadium indicated potential effects to fish health in 2018, which was also observed in 2016 and 2017. Concentrations of silver also indicated potential risk to fish health in 2018; however, this is the first year that the detection limit was below the effect criterion (0.003 mg/kg). The following were the results of screening for potential risks of chemical loadings in fish muscle tissues (Table 3.8 and Appendix A4):

- Concentrations of aluminum in FTMN, LKCH, and WHSC composites from Horizon Lake, and LKCH and WHSC composites from Calumet watershed exceeded the lowest no-effects threshold (see Table 2.10 for thresholds). FTMN from Horizon Lake also exceeded the lethal lowest effects threshold;
- Copper concentrations in FTMN, LKCH, and WHSC composites from Horizon Lake and the Calumet watershed exceeded the lethal lowest no-effects threshold, the lethal lowest effects threshold, and the sublethal lowest effects threshold (see Table 2.10 for thresholds). Copper also exceeded the sublethal lowest effects threshold in three adult WHSC;
- Selenium concentrations in all whole-body composite samples and adult WHSC tissue samples collected from Horizon Lake and the Calumet watershed exceeded one or more of the thresholds (see Table 2.10 for thresholds);
- Silver concentrations in LKCH and WHSC composites from Horizon Lake and WHSC composites from the Calumet watershed exceeded the lethal and sublethal lowest no-effects thresholds; and
- Vanadium concentrations in FTMN, LKCH, and WHSC composites from Horizon Lake and WHSC composites from the Calumet watershed exceeded the sublethal lowest no-effects threshold.

All five of the metals that exceeded human health consumption guidelines and/or were above the threshold that indicated potential effects to fish health in Horizon Lake also exceeded in Calumet watershed reference fish in 2018. This was the first year that silver was measured at a detection limit that was lower than the criteria limit (0.003 mg/kg) so it is not known if this analyte has exceeded in reference fish in past years (2009 to 2017); the other four metals have all previously exceeded in reference fish. Total metal concentrations in whole body composites collected from the Calumet watershed were generally lower than Horizon Lake in 2018 (Appendix A4).

Organic compounds in fish muscle tissues were generally below detection limits in 2018 (Appendix A4). All organic compounds that were above detection limits in composite samples from Horizon Lake were also above the detection limit in the Calumet watershed. Concentrations of all organics have remained well below the fish consumption guidelines since monitoring was initiated in 2012.

Table 3.8 Concentrations of metals in fish tissue from Horizon Lake and Calumet River that exceeded human health consumption guidelines and/or were above the threshold that indicated potential effects to fish health, October 2018.

Site		Horizon Lake												Calumet River	
Species	Units	WHSC (n=3)[1]			WHSC (n=3)[2]			WHSC (n=2)[3]			FTMN	LKCH	WHSC	LKCH	WHSC
Measurement Parameters		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Composite	Composite	Composite	Composite	Composite
Fish Length	mm	215	227	246	251	262	281	309	312	315	60-70	90-120	80-100	44-79[4]	80-100
Total Metals															
Aluminum (Al)-Total	mg/kg wwt	<0.40	0.44	0.53	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	***29***	**11**	***32***	**3.7**	**11**
Arsenic (As)-Total	mg/kg wwt	0.02	0.036	0.048	0.021	0.023	0.027	0.02	0.022	0.025	0.14	0.036	0.16	0.024	0.044
Chromium (Cr)-Total	mg/kg wwt	0.08	0.11	0.13	0.049	0.051	0.055	0.056	0.062	0.067	0.53	0.55	0.81	0.23	0.75
Copper (Cu)-Total	mg/kg wwt	0.21	0.22	0.24	0.23	0.27	0.32	0.3	0.36	0.41	***0.76***	***0.87***	***1.3***	***0.73***	***0.96***
Mercury (Hg)-Total	mg/kg wwt	0.093	0.11	0.12	0.08	0.12	0.17	0.12	0.14	0.16	0.041	0.069	0.032	n/a	0.033
Selenium (Se)-Total	mg/kg wwt	0.2	0.26	**0.31**	0.26	**0.28**	**0.3**	**0.3**	**0.31**	**0.33**	**0.54**	**0.51**	**0.46**	**0.44**	0.23
Silver (Ag)-Total	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0017	**0.0034**	**0.0067**	0.0012	**0.0047**
Vanadium (V)-Total	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.12	0.042	0.12	<0.020	0.048

[1] WHSC from the 200-250 mm size class.

[2] WHSC from the 251-300 mm size class.

[3] WHSC from the 301-350 mm size class.

[4] No fish were captured that were within the target size class (90-120 mm); therefore, smaller fish were composited.

n/a: not available.

Blue shaded value = exceedances of National USEPA and/or Region III USEPA criteria used for evaluating potential risk of fish consumption to human health (Table 2.9).

Threshold values were derived from effects data for fish muscle tissue presented in Jarvinen and Ankley (1999) and used in the JOSMP tissue program (JOSMP 2015). Additional information is presented in Table 2.10.

Bold value = exceeds lethal lowest no-effects threshold.

Underline value = exceeds sublethal lowest no-effects threshold.

Italics value = exceeds lethal lowest effects threshold.

Grey shaded value = exceeds sublethal lowest effects threshold.

3.5.3 Fish Production

3.5.3.1 Horizon Lake Fish Sampling

A total of 607 fish were captured during the fall 2018 sampling program in Horizon Lake, comprised of 85% forage fish, 11% sucker species, and 4% sportfish. In total, seven species were caught: ARGR, BRST, FTMN, LKCH, LNSC, TRPR, and WHSC (Table 3.9).

The relative abundance of FTMN in Horizon Lake appears to be increasing over time, coinciding with a decrease in LKCH relative abundance (Table 3.10). LCKH made up the highest proportion of the population from 2009 to 2014 while FTMN have comprised the highest proportion since 2015, except for 2016 when WHSC (33%) made up a slightly higher proportion than FTMN (31%). The percent composition for ARGR in 2018 was 4%, which was substantially higher than the 0 to 1% range observed in previous years; the percent composition of all other species (BRST, BURB, FTMN, LKCH, LNSC, SLSC, TRPR, and WHSC) were within the historical range (Figure 3.28).

The majority of fish captured in 2018 were from the shallow depth stratum (<2 m; n = 312), and were comprised primarily of FTMN (44%), LKCH (21%), TRPR (16%), and BRST (14%) (Table 3.9). The second highest catch was observed in the intermediate stratum (2 to 4 m depth; n = 208), while the lowest returns were observed in the deep stratum (>4 m depth; n = 87). The intermediate depth stratum was comprised primarily of FTMN (62%), WHSC (13%), and ARGR (9%), while the deep stratum has relatively even proportions of WHSC (29%), TRPR (23%), FTMN (22%), and LKCH (21%). Species richness ranged from 0 to 3 for fyke and gill nets and 0 to 4 for minnow traps in 2018 (Figure 3.29).

Electrofishing in Horizon Lake captured the fewest fish (n = 11), followed by fyke nets (n = 23), gill nets (n=62) and minnow traps (n = 511; 84% of all fish captured) (Figure 3.31). The amount of effort and CPUE for fyke netting, gillnetting, and minnow trapping were within the range of previous years, while electrofishing effort (1,360 sec) and CPUE (0.81 fish/100 sec) were lower than previous years (Figure 3.31).

A total of 78 ARGR have been captured in the fall sampling programs conducted between 2010 and 2018 (Figure 3.29). Twenty-four ARGR were captured in the fall of 2018, which was higher than all previous years. One ARGR was captured in the shallow depth stratum in 2018, 19 were captured in the intermediate depth stratum, and four were captured in the deep stratum. Historically, the majority of ARGR have also been captured in intermediate depth.

The proportion of forage fish in Horizon Lake generally decreased from 2009 to 2016 then increased in 2017 and 2018, while sucker species showed the opposite response (i.e., generally increasing from 2009 to 2016 then decreasing the past two years).

Fish Tracking

Echoview's fish tracking module identified 12,007 fish tracks across both night hydroacoustic surveys (6,715 fish tracks on night one and 5,292 on night two). Approximately 1.2% of fish detected (n = 143) were greater than 200 mm in length, with nine of these individuals longer than 400 mm. In comparison, 8.8% (n = 1,054) of fish identified in 2017 and 3.4% (n = 502) of fish identified in 2016 were longer than 200 mm, with 113 and 4 of these individuals longer than 400 mm, respectively. One fish greater than 400 mm was

detected in the shallow depth (night 2) while the remainder were distributed throughout the intermediate and deep strata of the lake. Conditions during the first night survey were calm while the second night survey was slightly windy, creating some wave and surface related background noise; however, the hydroacoustic data generated during both surveys were of a sufficient quality to allow population estimates to be calculated. The fish tracks are presented in Figure 3.32.

Table 3.9 Number of fish captured during the fish sampling program run concurrently with the hydroacoustic survey, organized by species and depth strata, 2018.

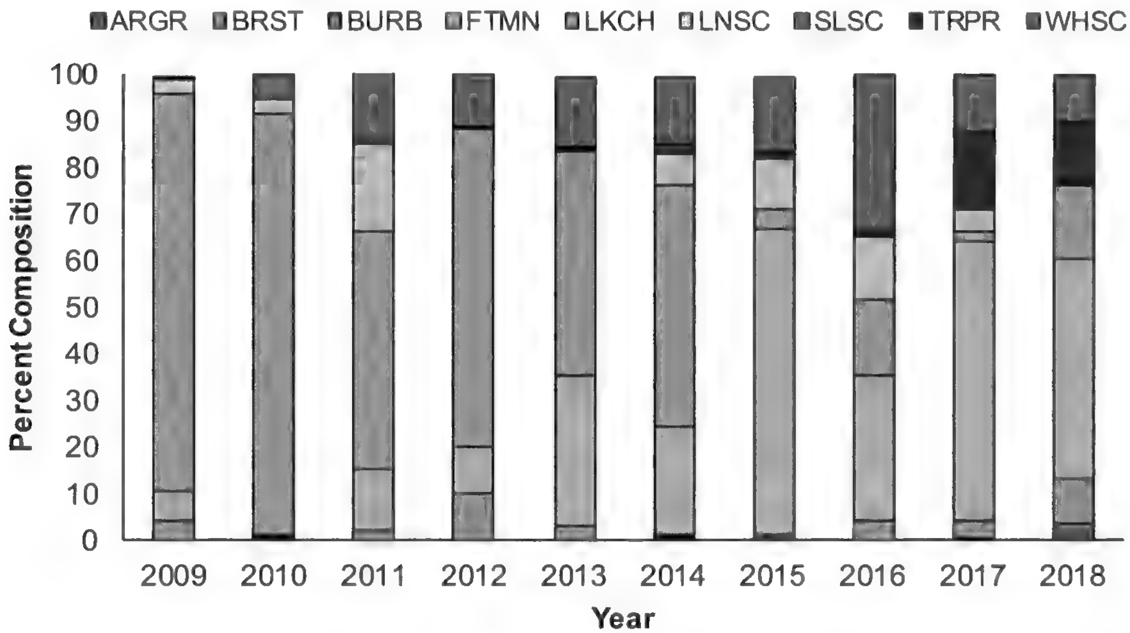
Species	<2 m Maximum Depth		2-4 m Maximum Depth		>4 m Maximum Depth		All Depths Combined	
	n	% of Capture	*n*	% of Capture	*n*	% of Capture	*n*	% of Capture
ARGR	1	0.32	19	9.1	4	4.6	24	4.0
BRST	45	14	13	6.3	0	0	58	10
FTMN	138	44	129	62	19	22	286	47
LKCH	66	21	11	5.3	18	21	95	16
LNSC	0	0	1	0.48	1	1.1	2	0.33
TRPR	51	16	8	3.8	20	23	79	13
WHSC	11	3.5	27	13	25	29	63	10
Total	**312**	**100**	**208**	**100**	**87**	**100**	**607**	**100**

Table 3.10 Relative proportions (%) of species captured during fall fish surveys, 2009 to 2018.

Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
ARGR	0	0.1	0	0.3	0	0.8	1	0.04	0.8	4.0	0.7
BRST	4.3	0.7	2.3	10	3.5	0.6	0.1	4.5	3.4	9.6	3.9
BURB	0	0	0	0	0	0.05	0	0	0	0	0.01
FTMN	6.3	0.7	13	10	32	23	66	31	60	47	29
LKCH	85	90	51	68	48	52	3.8	16	2.0	16	43
LNSC	3.2	3.2	19	0	0.5	7.0	11	14	4.8	0.3	6.3
SLSC	0	0.1	1.1	0.5	0	0.1	0.2	0.04	0	0	0.2
TRPR	0	0.1	0	0	0.5	1.9	1.5	1.2	17	13	3.5
WHSC	0.7	5.2	14	11	15	14	16	33	12	10	13

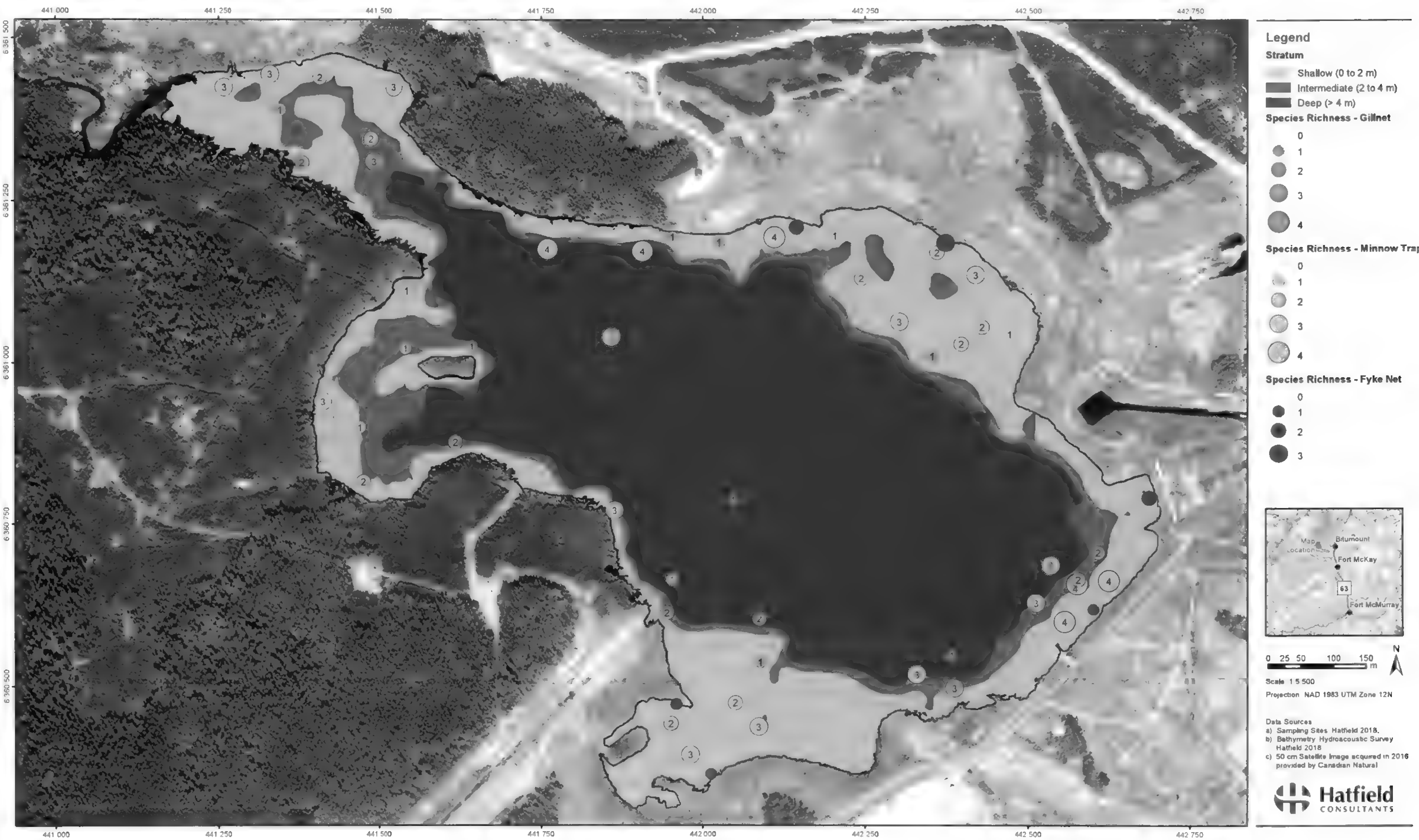
Note: If multiple fall sampling events were conducted (e.g., mark-recapture programs), the latter sampling event was used (typically the end of September or early October).

Figure 3.28 Relative proportions (%) of species captured during fall fish surveys, 2009 to 2018.



Note: If multiple fall sampling events were conducted (e.g., mark-recapture programs), the latter sampling event was used (typically the end of September or early October).

Figure 3.29 Species richness in Horizon Lake for minnow trapping, fyke netting, and gillnetting, October 2018.



Horizon Lake Monitoring Program 2018

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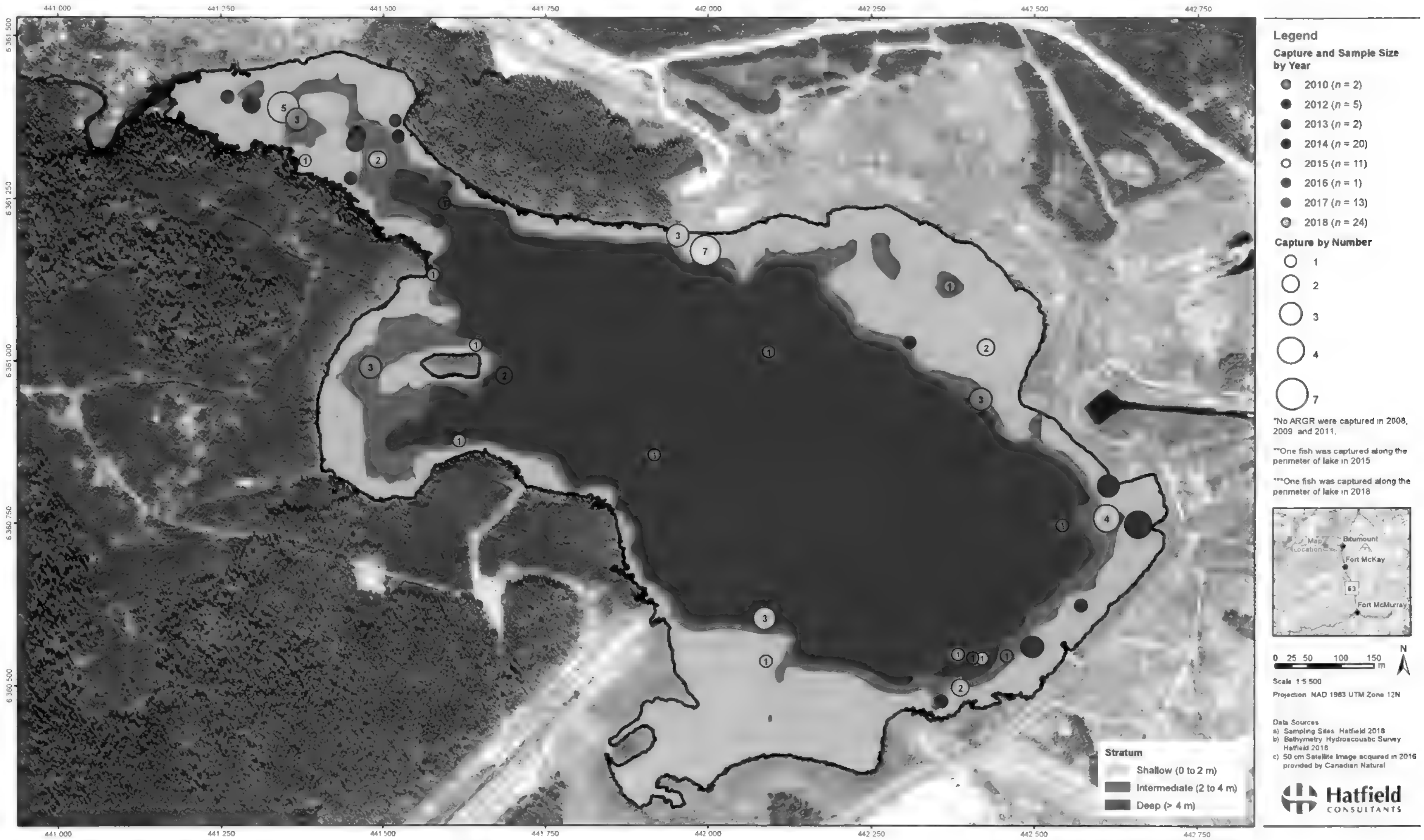
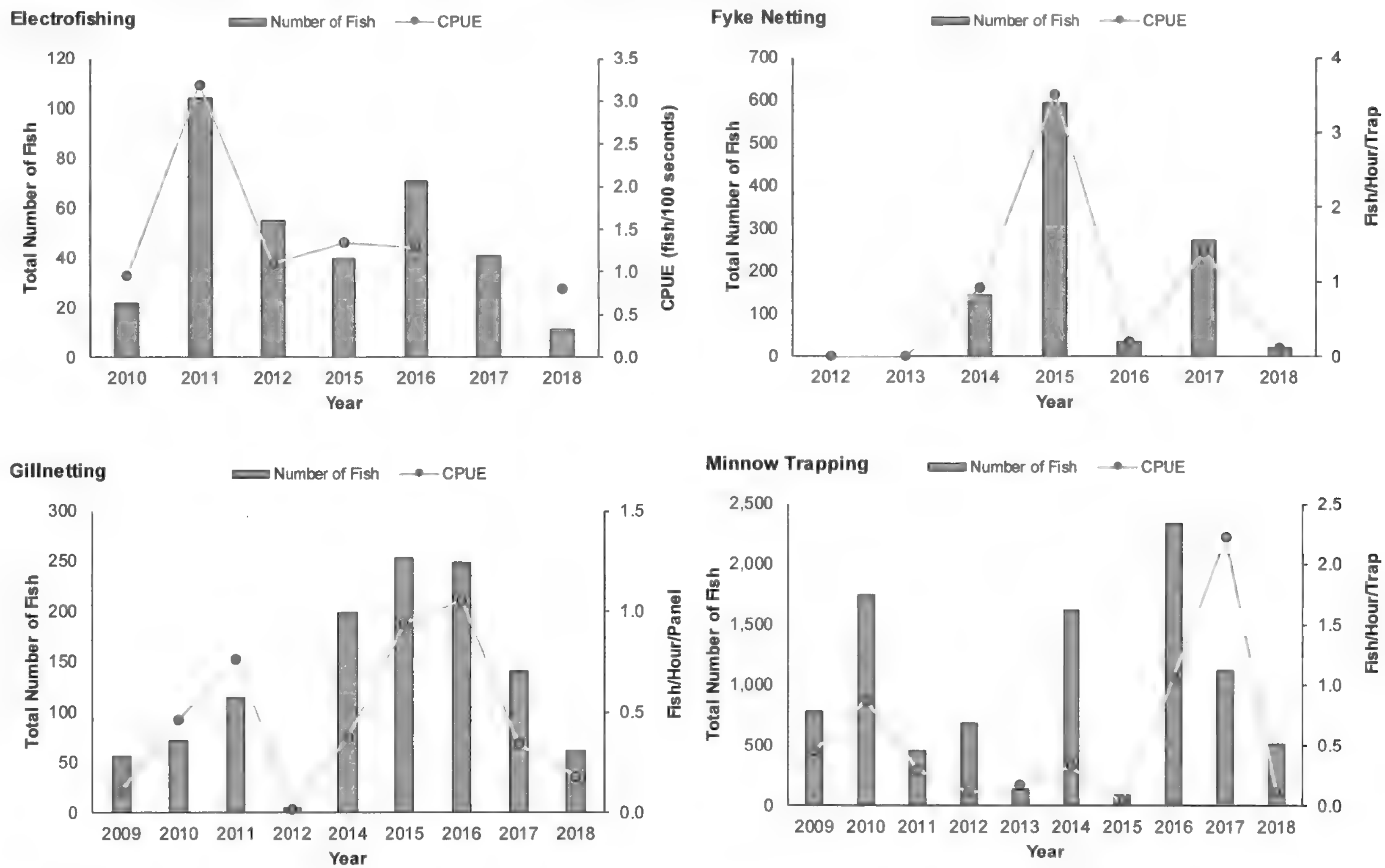
Figure 3.30 Locations where Arctic grayling were captured in Horizon Lake, Fall 2008 to 2018.



Horizon Lake Monitoring Program 2018

K:\Data\Project\CNRL9078-A_MXD\2018_Technical_Report\CNRL9078_Fig3_30_ArcticGraylingCaptures_HorizonLake_20190507_v_1_2_SS.mxd

Figure 3.31 Comparison of fall CPUE data for each gear type, 2009 to 2018.



Note: If multiple fall sampling events were conducted (e.g., mark-recapture programs), the latter of the two sampling events was used (typically the end of September or early October).

Electrofishing seconds were not recorded in 2017 so CPUE could not be calculated.

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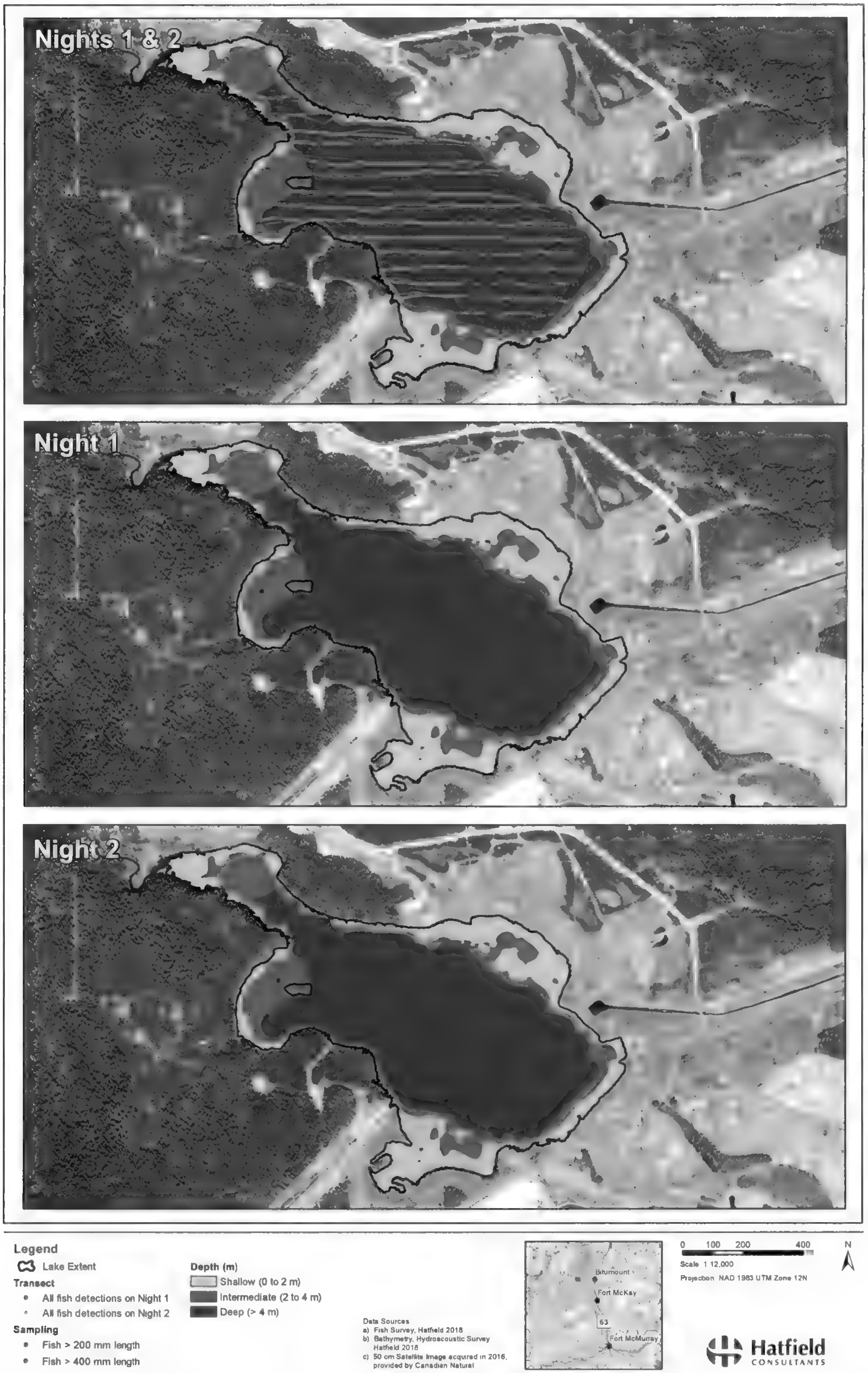
Figure 3.32 Location and relative size of fish detected during the hydroacoustic survey of Horizon Lake, 2018.



3.5.3.2 Abundance Estimates

Estimates of total fish abundance for Horizon Lake were generated from the October 2018 hydroacoustic weighted survey data presented in Table 3.11. Overall abundance has increased since 2015, with 2018 the second highest on record after 2014.

Table 3.11 Fish population abundance in Horizon Lake, estimated using annual hydroacoustic survey data collected from 2013 to 2018.

Population Estimate	2013[1]	2014[2]	2015[3]	2016[3]	2017[3]	2018[3]
Overall Abundance	103,349	171,069	131,308	134,684	137,713	139,763
95% CI (±)		-	36,090	65	24,652	33,623

[1] Overall abundance estimate from hydroacoustic survey 4 using echo integration methods, due to a dense layer of zooplankton that was thought to inflate estimates of surveys 1 and 2. Estimates include fish detectable with hydroacoustic settings (>50 mm) and did not include fish back-calculated using instantaneous mortality rate (Golder 2014).

[2] Overall abundance was calculated as the average of the 50% median across all surveys. Estimates include fish detectable with hydroacoustic settings (>50 mm) and did not include fish back-calculated using instantaneous mortality rate.

[3] Overall abundance was calculated as the average of night 1 and night 2 weighted estimates.

Estimates of species-specific abundance are provided in Table 3.12. The abundance of ARGR and BRST have increased since 2016 and 2015, respectively, with the highest abundance recorded in 2018 (Table 3.12). In contrast, the abundance of LNSC and WHSC has decreased since 2016 and 2015, respectively, with the lowest recorded abundance in 2018 for both species (Table 3.12). The abundance of FTMN, LKCH, and TRPR were within the range of previous observations, while 2018 was the second consecutive year that SLSC were not captured in Horizon Lake.

Table 3.12 Species-specific abundance estimates based on specific percent composition, hydroacoustic density data, and depth strata.

Species	2013 Overall Abundance	2014 Overall Abundance[1]	2015 Overall Abundance[2]	2016 Overall Abundance[2]	2017 Overall Abundance[2]	2018 Overall Abundance[2]
ARGR	868	1,371	1,350	50	1,137	5,526
BRST	0	492	135	6,049	4,722	13,355
FTMN	4,336	26,432	86,774	42,245	82,799	65,852
LKCH	32,499	70,018	4,993	21,297	2,798	21,874
LNSC	33,602	42,797	14,440	18,748	6,558	461
SLSC	0	23	270	50	0	0
TRPR	1,942	5,273	2,024	1,600	23,257	18,190
WHSC	35,435	24,672	21,322	44,645	16,350	14,506
Unidentified	0	0	0	0	88	0

[1] Overall abundance of EI surveys combined in Table 4.3-5 (Golder 2015). Estimates include fish detectable with hydroacoustic settings (>50 mm) and did not include fish back-calculated using instantaneous mortality rate (Golder 2015).

[2] Overall abundance was calculated as the average of night 1 and night 2 weighted estimates.

3.5.3.3 Biomass and Production

Data used to estimate biomass and production (i.e., abundance-at-age, length-at-age, weight-at-age, and instantaneous growth rate) are provided in Appendix A7. WHSC and ARGR contributed the majority of the production and biomass in 2018, followed by FTMN and LKCH (Table 3.13 and Figure 3.33). The estimated contribution of LNSC to fish biomass and productivity in Horizon Lake was small in 2018, which was the result of the historically low captures in the fish sampling program (see Section 3.5.3.1).

Production and biomass estimates were relatively low for both sucker species in 2018, which resulted in an overall production estimate of 1,100 kg/year. Historically, LNSC and WHSC have been the primarily contributors to production and biomass in Horizon Lake.

As was noted in the summary of the 2017 program, the production estimates are based on the relative abundance of each fish captured, which determines the fish population size estimates, and the lengths of the captured fish, which determines the per-fish production estimates. The very low number of captured LNSC in 2018 (i.e., 2 fish in the fall monitoring program, Table 3.9) resulted in a low estimate of the contribution of LNSC to the fish community in 2018. As a result, the LNSC contributions to overall production and biomass are negligible.

Much of the variation in estimated abundance, and consequently production and biomass, appears to be caused by capture success. The age distributions of large- and small-bodied fish in Horizon Lake have been relatively stable since 2015 (i.e., the first year with an expanded consistent program of fish age data collection; Figure 3.34 and Figure 3.35). The stable age distributions are evidence for consistent recruitment and age-dependent mortality; however, the limited number of captured LNSC present a challenge to determining the trajectory of this species in Horizon Lake.

ARGR were included in the biomass and production estimates for the first time in 2018. The relatively high capture rate for grayling in 2018 permitted the collection of sufficient numbers of length-weight-age observations to support growth rate and production modeling. These first estimates of ARGR productivity required the assumption that individual growth rates have been consistent since 2015, since it was necessary to pool all length-weight-age observations across that period to construct the Von Bertalanffy growth model. The uncertainty in the ARGR production and biomass estimates are likely greater because of this simplifying assumption and the limited number of observations available for the growth rate and production modeling.

Table 3.13 Estimates of production and biomass for significant Horizon Lake fish species, 2018.

Species	Production (kg/year)		Biomass (kg)		P:B ratio	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
ARGR	420	280 to 830	980	680 to 1,500	0.43	0.31 to 0.62
FTMN	110	70 to 150	160	110 to 220	0.68	0.50 to 0.75
LKCH	85	53 to 140	220	150 to 310	0.38	0.29 to 0.51
LNSC	14	9.4 to 22	83	58 to 120	0.17	0.15 to 0.20
WHSC	440	240 to 760	1,200	820 to 1,800	0.35	0.26 to 0.46
Total	**1,100**	**820 to 1,600**	**2,700**	**2,200 to 3,500**	**0.40**	**0.34 to 0.49**

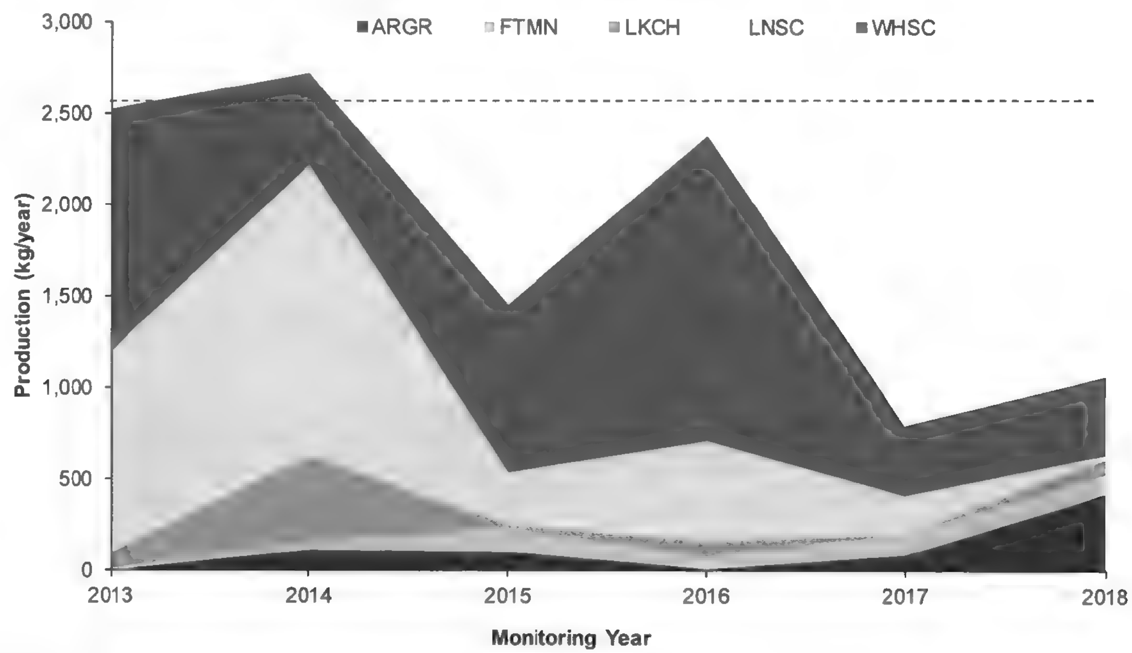
Table 3.14 Comparison of production and biomass estimates for Horizon Lake, 2013 to 2018.

Species	Production (kg/year)						Biomass (kg)						P:B ratio					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
ARGR	-	110	103	4	90	420	-	250	240	9	200	980	-	0.4	0.4	0.4	0.4	0.4
FTMN	4	39	128	72	110	110	10	110	227	117	160	160	0.4	0.4	0.6	0.6	0.7	0.7
LKCH	95	470	19	82	4	85	167	620	50	142	31	220	0.6	0.8	0.4	0.6	0.1	0.4
LNSC	1,093	1,600	291	551	210	14	5,766	5,000	3,220	3,323	1,200	83	0.2	0.3	0.1	0.2	0.2	0.2
WHSC	1,332	510	920	1,670	380	440	4,314	1,100	2,526	5,112	1,400	1,200	0.3	0.5	0.4	0.3	0.3	0.4
Total	**2,524**	**2,700**	**1,461**	**2,379**	**790**	**1,100**	**10,257**	**7,100**	**6,263**	**8,702**	**3,000**	**2,700**	**0.2**	**0.4**	**0.2**	**0.3**	**0.3**	**0.4**

Note 1: An error was discovered in the species compositions that were used for the 2015 and 2016 production estimates, while investigating how to incorporate the length distributions from the hydroacoustic survey into the species composition numbers in 2018,. This error skewed the previously reported results towards large-bodied species. After reanalyzing with the correct species compositions, the overall production estimates decreased from 3,600 to 1,461 kg/year in 2015 and from 2,800 to 2,379 kg/year in 2016.

Note 2: The contribution of ARGR in 2013 is expected to be negligible because of low captures (n = 2).

Figure 3.33 Comparison of production estimates for Horizon Lake, 2013 to 2018.



Dashed line represents the production (2,543 kg/year) required under the DFO Authorization.

Figure 3.34 Age distributions of Arctic grayling, white sucker, and longnose sucker in Horizon Lake, 2015 to 2018.

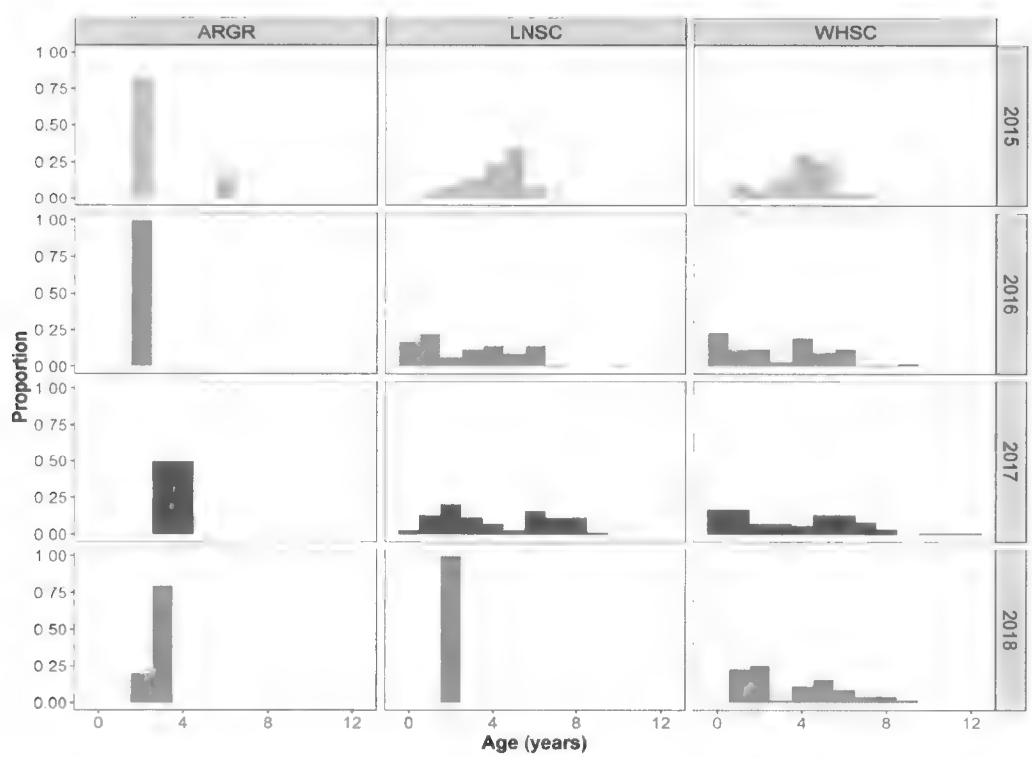
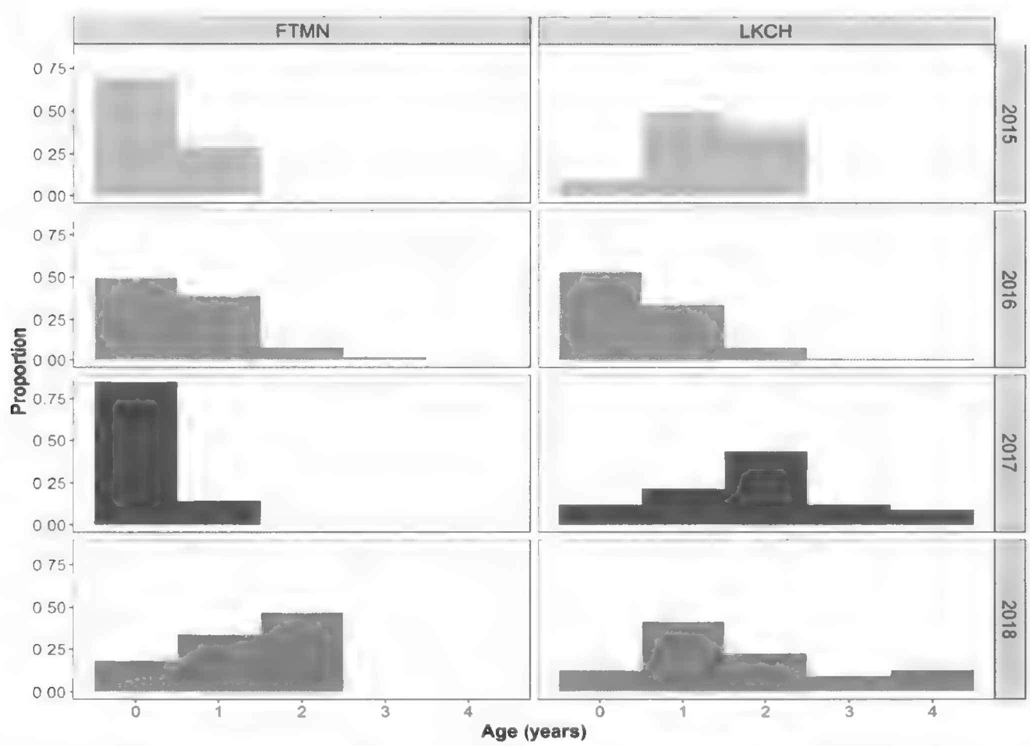


Figure 3.35 Age distributions of fathead minnow and lake chub in Horizon Lake, 2015 to 2018.



3.5.3.4 Fish Production Estimates Uncertainties

The fish production estimates for 2017 and 2018 were less than the previous three years, with each year providing less than half the 2,543 kg/year of total production stipulated in the Fisheries Act Authorization for the Project. Some of the variation in production rates can be attributed to uncertainty in the relative abundance of different species that are calculated from the results of the fish capture program. For example, relatively low LNSC capture rates in 2017 and 2018 have resulted in low estimates of LNSC abundance, whereas the substantial increase in ARGR capture rates in 2018 resulted in relatively large estimates of ARGR abundance and productivity. Uncertainties in abundance, and subsequently biomass and productivity, may result from high capture rates for small-bodied fish in minnow traps, poor fishing success with electrofishing, and size-selection bias in the capture program.

An alternative method of estimating population sizes for the dominant fish species was developed for the 2018 results (Appendix A7.6). This method used the fish lengths measured by the hydroacoustic survey to estimate the abundance of fish in a series of size classes, which were then combined with the abundance of fish in the same size classes from the fish capture program. The aim of this alternative method was to incorporate the length information from the hydroacoustic survey into the abundance estimates, and potentially compensate for uncertainties caused by gear selectivity in the fish capture program. Table 3.15 summarizes the results of the alternative method. The abundance, biomass, and productivity of LNSC and WHSC increased substantially relative to the estimates from the established method in Table 3.13, but these gains were offset by decreased ARGR production. Overall biomass and productivity remained approximately the same as the established method. The similar results that were obtained from the two methods were the result of two processes: the limited contribution of small fish, regardless of species, to overall production; and, the trade-off of the contributions to production between the large-bodied species.

Table 3.15 Fish species abundance, production, and biomass estimates based on hydroacoustic length observations.

Species	Abundance (S.D.)	Biomass (kg)	Production (kg/year)	P:B Ratio
ARGR	1,198 (71)	213	92	0.43
LKCH	26,082 (3,169)	264	101	0.38
FTMN	45,869 (9,616)	111	75	0.68
WHSC	22,083 (3,176)	1,868	662	0.35
LNSC	5,361 (501)	966	169	0.17
Total	**100,593**	**3,422**	**1,099**	**0.32**

While investigating how to incorporate the length distributions from the hydroacoustic survey into the species composition numbers in 2018, an error was discovered in the species compositions that were used for the 2015 and 2016 production estimates that skewed the results towards large-bodied species. After reanalyzing with the correct species compositions, the overall production estimates decreased from 3,600 to 1,461 kg/year in 2015 and from 2,800 to 2,379 kg/year in 2016. These estimates were lower than 2013 and 2014 and higher than 2017 and 2018 (Table 3.14). Appendix A1 provides a more detailed description of the data processing error that led to the inaccurate production estimates for 2015 and 2016.

The peak production observed to date in Horizon Lake occurred during the first two years of hydroacoustic monitoring, measuring 2,524 kg/year in 2013 and 2,700 kg/year in 2014, which were close to the offsetting target of 2,543 kg/year stipulated in the Project Authorization. Three of the four production estimates since 2015 have been substantially lower than these first two years, although 2016 was high and at 2,379 kg/year was also near the annual production target. The general trend over the last six years of production monitoring appears to show a decreasing trend; however, future monitoring will be important to determine whether the large-bodied fish species in Horizon Lake are stabilizing or declining, or whether there is simply high annual variability in these populations. A pattern of declining and then stabilizing production would not be unexpected following the creation of a reservoir-type lake, due to the initial pulse of nutrients and creation of new habitat that results in an increase in resources for benthic invertebrates and fish. In bThe production results through 2018 suggest that fish populations may have peaked near the start of production monitoring and are now reaching a state of equilibrium in the lake; an additional year of production data will provide further evidence of whether the 2017 and 2018 results are broadly representative of an equalized state, and if the relatively high production estimate observed in 2016 was an anomaly or within the expected range of annual variability.

The uncertainties in fish production estimates have been the focus of discussion and additional analyses after the observed decrease in production in 2017. The 2018 fish production estimates were greater than the 2017 estimates but remained lower than estimates from previous years. The hydroacoustic length data can be used to correct for some uncertainties in the relative abundance of different fish species, but the hydroacoustic estimates are also subject to their own assumptions and potential biases. The monitoring program continues to observe a variety of forage and large-bodied fish species across a range of ages, which is indicative of relatively stable recruitment and age-dependent mortality.

3.5.4 eDNA Sampling

During the field assessment, a relatively high proportion of suspended particulate matter was observed in the Horizon Lake water column compared to the Tar River. The windy conditions that were creating waves in the lake could have been a major contributing factor for suspending particulate matter. Recorded water temperature at the surface of Horizon Lake ranged from 4.5 - 4.8°C. Analytical results for DOC and TSS for three sites at Horizon Lake ranged from 16 to 18 mg/L DOC and 6.7 to 11 mg/L TSS. Total tannins and lignins were 0.92 mg/L at deep Horizon Lake sample location.

During eDNA analysis PBI implemented QA/QC protocols including the use of positive amplification controls to verify qPCR assay performance, no template controls to detect the potential presence of sample or reagent contamination, and duplicate reactions to test for PCR inhibition using an external positive control. The QA/QC protocols confirmed the species-specific assay performance and the absence of contamination. Inhibition was observed in the eDNA sample from one site: however, inhibition was successfully removed for sample analysis using species-specific assays.

All three positive controls for Arctic grayling (sample IDs ConAG-1a, ConAG-1b, and ConAG-2) had 100% positive detection of Arctic grayling eDNA. The negative control had 0% detection of either Arctic grayling or burbot. The controls provide verification that the eDNA sampling method is effective at collecting eDNA from a site where the target species is known to be present, that decontamination procedures were effective, and that the species-specific Arctic grayling assay is working effectively.

The sample location within Horizon Lake near the inlet of the Tar River, was the only site that had a positive detection of Arctic grayling eDNA. Arctic grayling was captured at two sample locations during the conventional sampling program the previous day. However, detection of Arctic grayling eDNA at the second location was negative. None of the sites had positive detection of burbot eDNA and burbot were not captured during the conventional sampling program prior to eDNA sampling.

4.0 STATE OF THE LAKE

The results of the first ten years of monitoring have demonstrated that Horizon Lake provides a variety of functional habitats and food sources that are suitable to support year-round fish populations, and that the physical and chemical environment is well suited to the establishment and proliferation of aquatic life. Key findings are summarized in Table 4.1.

Table 4.1 A summary of key findings from the ten years of Horizon Lake monitoring.

Environmental Quality
▪ Key water quality indicators of an aquatic system's ability to support biological colonization have been within relevant guidelines for the protection of aquatic life since monitoring began in 2008. ▪ Seasonal water quality monitoring has shown low temporal variability, and similar conditions to those documented in the Tar River by RAMP/JOSMP. ▪ Winter DO profiles measured each year from 2008 to 2018 have confirmed that suitable oxygen levels continue to be available to support overwintering of all fish species present in Horizon Lake.
Food Web and Lower Trophic Levels
▪ An initial pulse of nutrients occurred from inundated vegetation and soils following lake construction. This pattern was predicted as a result of back-flooding that occurred after the lake construction in 2008, which can cause the organic carbon in soils and plant materials to decompose and release the stored nutrients and metals. This pulse was also evident in mercury concentrations in fish, which have decreased since 2012. ▪ The lake is stabilizing to an upper mesotrophic to slightly eutrophic nutrient regime, which will continue to provide nutrients for the growth of primary producers and sustain the aquatic foodweb. ▪ Annual sampling has shown that the lake supports an abundant and diverse benthic invertebrate community, and moderately abundant phytoplankton and zooplankton communities.
Fish Habitat
Horizon Lake has a range of fish habitat that provide foraging and cover habitat for a range of small- and large-bodied fish. Observed habitat types include: ▪ gradual and steep sloping littoral areas; ▪ varied substrates, including soft bottomed areas with extensive macrophyte production, angular cobble/boulder gardens, and rocky reef features; ▪ a well-developed and diverse macrophyte community; and ▪ a large profundal zone that provides habitat for plankton and the fish species that forage on these organisms.

Table 4.1 (Cont'd.)

Fish Community
▪ Horizon Lake supports ten species of small-bodied and large-bodied fish, including lake chub, fathead minnow, white and longnose sucker, and Arctic grayling. ▪ The PIT antenna system has detected 1,274 of the 4,078 tags in the tag database since the installation of the first antenna array in 2013, demonstrating that fish from the lake are using the upper Tar River and providing clear evidence of population connectivity and recruitment. ▪ The range of ages observed in Horizon Lake suggests that the sucker populations are stable and reproducing. The presence of older fish indicate that mature adults are present and have the potential to contribute to lake productivity and spawning, whereas the presence of younger fish demonstrate ongoing recruitment success. ▪ Hydroacoustic monitoring has been conducted annually for the last six years. The resultant production estimates were near or above the total production requirement of 2,543 kg/year that is stipulated in the DFO Authorization in three years (2013, 2014, and 2016) and below this target in the other three years (2015, 2017, and 2018). The remainder of the production offsetting is expected to be provided by the diversion channel that will connect the lake with the Athabasca River when the mine approaches its closure phase in 2044. ▪ The general trend over the last six years appears to show a decreasing trend in lake production; however, future monitoring will be important to determine whether the large-bodied fish species in Horizon Lake are stabilizing or declining, or whether there is simply high annual variability in these populations. ▪ The lack of connectivity of the lake to the lower Tar River and the current species composition (i.e., no piscivorous fish) may affect the lake's ability to meet the prescribed production target.

5.0 CONCLUSIONS

The primary objective of the 2018 Program was to estimate fish population size and annual fish productivity for Horizon Lake. Chemical, physical, and other biological components of the lake were also monitored to assess ecological progression and function.

Water quality in Horizon Lake in 2018 was generally similar to historical conditions. The majority of measured analytes were within relevant water quality guidelines for the protection of aquatic life, were within the ranges previously observed in Horizon Lake, and within or below the range of concentrations observed in the Tar River.

All metal concentrations in sediments were below applicable interim sediment quality guidelines (ISQG) and probable effects levels (PEL) at all three lake sites in 2018, except for arsenic, which has exceeded in all previous years. Exceedances of the arsenic ISQG were also observed in pre-disturbance monitoring (www.ramp-alberta.org) of the Tar River (33%, n=3) and the Calumet River (21%, n=11). Hydrocarbon concentrations were below detection limits, except for Fraction 3 at BEN-2 and BEN-3; however, concentrations were below the ISQG at both sites and below the range of historical observations at BEN-3. Concentrations of all PAHs were below ISQ and PEL guidelines in 2018, and well below the Hazard Index threshold of 1.0, suggesting there is low potential for PAH and total hydrocarbon toxic effects on the aquatic life in Horizon Lake.

The phytoplankton community in Horizon Lake was comprised of a high density of cryptophytes, followed by diatoms and cyanobacteria, which have also been abundant in previous years. Cyanobacteria and dinoflagellates comprised the majority of biomass in 2018. Cyanobacteria has been the most dominant taxa by biomass since monitoring began, with the exception of 2017. Average phytoplankton density and biomass have shown seasonal fluctuations from year-to-year; 2018 observations were within the historical range in spring and fall and below this historical minimum in summer. Horizon Lake has generally supported a moderate to highly diverse phytoplankton community. Low evenness indicates that the abundance of phytoplankton taxa is not equal within Horizon Lake and the community is dominated by high abundances of a few taxa.

Mean zooplankton density and biomass were within the range of previous years in 2018, with rotifers and ciliates contributing the highest density and biomass in all seasons; rotifers have generally made up the highest proportion of the density and biomass in all seasons in previous years. The presence of ciliates has not been consistent from year-to-year, with observations in all three seasons of annual monitoring occurring only in 2012, 2015, 2017, and 2018. Overall, Horizon Lake supports a low to moderately diverse and moderately variable zooplankton community. Similar to the phytoplankton community, low evenness indicates that the abundance of individual zooplankton taxa is not equal in Horizon Lake and the community is dominated by a few taxa.

Natural variability has been observed in phytoplankton and zooplankton taxonomic richness, biomass, abundance, and community composition in Horizon Lake. The seasonal and temporal variations in phytoplankton community composition are likely caused by short-term changes in nutrient composition and other physical factors within the lake (e.g., fluctuations in water depth, wind mixing, and temperature).

Chironomid midges (Diptera) were the most abundant taxon by density in all three depth strata in 2018. Phantom midges (Chaoboridae) and oligochaete worms were also dominant contributors to mid-lake density, while the second most common taxon at the littoral and near-shore areas was oligochaete worms. Similar to previous years, average benthic invertebrate density and richness were highest in the near-shore area, followed by the littoral area, and the mid-lake area in 2018. This was expected given shallower lake regions generally have greater amounts of oxygen and primary production, higher habitat heterogeneity, and greater food resources available. It is also known that habitats that receive limited light exposure (i.e., deeper waters) are known to deter colonization by many benthic invertebrate species. Benthic invertebrate communities have generally been dominated by collector-gatherers at all areas in all years. Near-shore benthic invertebrate communities have generally contained a higher number of functional feeding groups, including macrophyte herbivores, omnivores, scrapers, and shredders. This is indicative of a greater number of food sources available closer to shore, and adequate nutrients and light for periphyton and phytoplankton to flourish. The percent of sensitive taxa has generally been low (less than 1%) at all areas in all years. Overall, the benthic invertebrate community in Horizon Lake suggests an improvement in habitat quality since monitoring began, which may be a result of more diversity in primary production and food sources for invertebrates, and more available niches. Fluctuations are likely reflecting seasonal variation in temperature and water quality, as increasing baseline diversity and evenness are creating robustness within populations.

A total of 2,084 fish were captured during the spring migration program, consisting primarily of forage fish caught in minnow traps. Fathead minnow were by far the most abundant species, comprising 92% of the total forage fish captures. The remaining 8% of the forage fish community included lake chub, brook stickleback, slimy sculpin, and a single trout-perch. 93 large-bodied fish were captured, consisting of five Arctic grayling and near equal proportions of longnose (n=46) and white sucker (n=47); most of these large-bodied fish were captured in fyke nets deployed between May 22 and 24.

The PIT antenna system has detected 1,274 of the 4,078 tags in the tag database (31%) since the installation of the first antenna array in 2013. The number of observations per year has varied, particularly since the installation of the upstream antennae in early 2016. The timing of upstream residence varies among species and among years, based on the three years of concurrent lower and upper PIT tag antennae data (2016 to 2018). Generally, the first upstream movements for Arctic grayling, longnose sucker, and white sucker were all observed in early May. All three species also show upstream movement throughout the summer, although most upstream movements were observed prior to the end of June. Longnose sucker were observed to have the longest and most frequent upstream durations in summer 2018, relative to other species and to previous years. In addition, a bi-modal distribution of upstream trips may be evident for longnose suckers. Arctic grayling have also exhibited extended upstream residence times, although the number of records is limited.

Snorkel surveys were used to visually assess species assemblages, fish distribution, fish abundance, and habitat use in the upper Tar River. There were a limited number of observations in 2018, which may have been due to the timing of the survey, which occurred from May 29 to June 2, after the spring migration period for Arctic grayling and white sucker and in between the bi-modal distribution of upstream trips for longnose sucker.

Over the past three years, there has been a substantial movement of fish in the spring. Based on life-histories of these fish and observations from the fish fence program in previous years, these movement are likely spring spawning migrations, suggesting the Tar River provides suitable spawning habitat for resident fish and contributes to the recruitment of fish to Horizon Lake.

Total and methyl mercury concentration in FTMN and LKCH composite samples from Horizon Lake generally decreased from 2010 to 2017, before increasing slightly in 2018. Total and methyl mercury in juvenile WHSC composite samples collected from Horizon Lake in 2018 were the lowest observed since monitoring began in 2011. This is the first year since monitoring began that concentrations of total and methyl mercury in WHSC composite fish collected from Horizon Lake were lower than concentrations in fish collected from the Calumet watershed; insufficient numbers of LKCH and FTMN were captured to allow Calumet reference watershed comparisons to be made in 2018. As in previous years, all the composite samples were below the Health Canada (2007a) guidelines for subsistence fishers (0.2 mg/kg) and general consumers (0.5 mg/kg) in 2018. This was the first year that total mercury concentrations in all adult WHSC muscle tissue samples were below the 0.2 mg/kg Health Canada (2007a) guideline for subsistence fisheries, and median concentrations of both total and methyl mercury in 2018 were lower than all previous years.

Concentrations of total metals in adult white sucker fish tissue samples collected in 2018 were below human health consumption guidelines, with the exception of arsenic, chromium, and mercury, which exceeded the National USEPA and/or Region III USEPA guidelines; concentrations of arsenic and chromium exceeded in all samples collected from Horizon Lake and the Calumet reference watershed, while mercury exceeded in all adult WHSC samples and the LKCH composite from Horizon Lake.

An error was discovered in the species compositions that were used for the 2015 and 2016 production estimates that skewed the results towards large-bodied species, while investigating how to incorporate the length distributions from the hydroacoustic survey into the species composition numbers in 2018, After reanalyzing with the correct species compositions, the overall production estimates decreased from 3,600 to 1,461 kg/year in 2015 and from 2,800 to 2,379 kg/year in 2016.

Abundance and production estimates for 2018 were calculated from hydroacoustic survey and fish capture data. The 2018 fish production and biomass estimates were higher than the 2017 estimates but remained lower than estimates from all other years (2013 to 2016).

The peak production observed to date in Horizon Lake occurred during the first two years of hydroacoustic monitoring, measuring 2,524 kg/year in 2013 and 2,700 kg/year in 2014, which were close to the 2,543 kg/year of total production that Canadian Natural is required to provide to offset the impacts of the Project. Three of the four production estimates since 2015 have been lower than these first two years, although 2016 was high and at 2,379 kg/year was also near the annual production target. Fish production was 1,100 kg in 2018, which was higher than 2017 (790 kg/year) but lower than all other years of hydroacoustic monitoring. The general trend over the last six years of production monitoring appears to show a decreasing trend; however, future monitoring will be important to determine whether the large-bodied fish species in Horizon Lake are stabilizing or declining, or whether there is simply high annual variability in these populations.

Much of the variation in estimated abundance, and consequently production and biomass, appears to be caused by capture success. The age distributions of large- and small-bodied fish in Horizon Lake have been relatively stable since 2015 (i.e., the first year with an expanded consistent program of fish age data collection). The stable age distributions are evidence for consistent recruitment and age-dependent mortality. However, the limited number of captured LNSC present a challenge to determining the trajectory of the LNSC species in Horizon Lake.

A habitat enhancement structure consisting of a rock V-weir and excavated scour pool was constructed across the width of the Tar River in 2012, as part of the amended DFO Authorization # ED-03-1183. The primary objective of this enhancement was to create summer feeding and overwintering habitats for Arctic grayling with the goal of promoting the establishment of this species in Horizon Lake. Monitoring of this weir indicates that there is seasonal use by Arctic grayling and other fish species within and around the rock weir. The structural integrity of the rock weir continues to be stable, with no changes over numerous spring freshets. Beaver activity will continue to be monitored and additional mitigation will be undertaken in 2019 to minimize the availability of trees for beavers to use. As outlined in letter 03-HCAA-CA-01183 on January 27, 2012 from Fisheries and Oceans Canada, 2018 is the last year of fish and water quality monitoring for the weir.

Arctic grayling eDNA was detected at one site in Horizon Lake while burbot eDNA was not detected at any of the sample sites. Potential explanations for no detection of Arctic grayling and burbot eDNA include: low abundance or absence of the target species in the vicinity of the sample sites at the time of field sampling; concentrations of DNA in the lake were below the limit of detection for the assay, which may be due to a low rate of DNA "shedding" to the environment or a high rate of DNA degradation; the latter is considered unlikely due to low water temperatures.

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APPENDICES

Appendix A1

Historical Production Estimates Memo

Hatfield
CONSULTANTS

MEMO

Date: June 26, 2019

HCP Ref No.: CNRL9078

From: Benjamin Beall, Meghan Isaacs, and Dan Moats

To: Devon Versnick-Brown and Joanne Hogg (Canadian Natural)

Subject: Recalculation of the 2015 and 2016 Production Estimates

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While investigating how to incorporate the length distributions from the hydroacoustic survey into the species composition numbers in 2018, an error was discovered in the species compositions that were used for the 2015 and 2016 production estimates, which skewed the results towards large-bodied species

An Excel pivot table was used to calculate species composition. Instead of using summing the number of individuals, the pivot was created by summing the number of rows using the species column. This resulted in an under-estimate of small-bodied fish and an over-estimate of large-bodied fish because it did not include tallies of unlengthed fish. These numbers were sent to BioSonics and were used for the production estimates in 2015 and 2016, resulting in substantially higher production estimates than when run with the correct compositions.

After reanalyzing with the correct species compositions, the overall production estimates decreased from 3,600 to 1,461 kg/year in 2015 and from 2,800 to 2,379 kg/year in 2016.

Audit and Quality Control Processes for the Fish Population Analyses

The quality control processes for the fish population analyses were expanded in 2018 in response to the identified deficiencies. The additional quality control reviews and audit processes were applied to the population estimates for 2015, 2016, 2017, and 2018, which resulted in revised population estimates for 2015 and 2016. The revised quality control and audit functions can be divided into three areas: (1) quality control of data inputs for the fish production modeling; (2) model review and validation; and (3) validation and cross-checking of estimates.

The data input audits and quality control processes are summarized below:

- Independent review of total population size estimates from the bioacoustics analyses, conducted by BioSonics, by Hatfield personnel;
- Review and validation of fish capture data, including species coding, data review of length/weight/age data, and validation of the number of fish capture observations against field records.

The model review and validation steps are the following:

- Review of the length-weight models using residual, Q-Q, and leverage plots.

- Identification and removal of outliers, if necessary, based on review of length-weight model performance and diagnostic plots.

- Review of the growth models using model plots and bootstrapping analysis. In the case of insufficient data or poor coverage of data, alternative linear models are available.

- Interannual comparison of growth model parameters.

The final component of the revised audit and quality control processes was the validation and cross-checking of the population estimates:

- Species composition (i.e., relative abundance of fish species) was independently calculated from the working data for the modeling, and validated against the results of the fish capture and hydroacoustic surveys.

- The number of observations used for the age-length keys were validated against the fish capture data. The number of age-length key observations should match the number of length-weight-age fish capture observations in the case of analyses using capture data from a single year (e.g., WHSC in 2018). If the models required fish capture data from multiple years, then the number of age-length key observations will be greater.

The validation of the model and the production estimate process were all conducted using scripts in R. All validation steps and results were captured within the scripts, in saved serial data objects, and exported to the output spreadsheets. This approach ensures that all steps in the production estimate process are transparent and accessible, including the quality control and audit components.

Appendix A2

Fish Compensation Habitat Monitoring Figures and Tables

Figure 1 Upper Tar River PIT Antenna Locations.

Figure 1: Tar River Rock Weir and Pit Antenna Locations	Legend: Rock V-Weir, PIT Antenna	Canadian Natural
	Date: September 18, 2018	
	Basemap: 2018 Spring 0.5 m	
	Kilometers 0 0.175 0.35 0.7 1.05 1:10,000	

Figure 2 Climate and Hydrology Monitoring Station Locations.

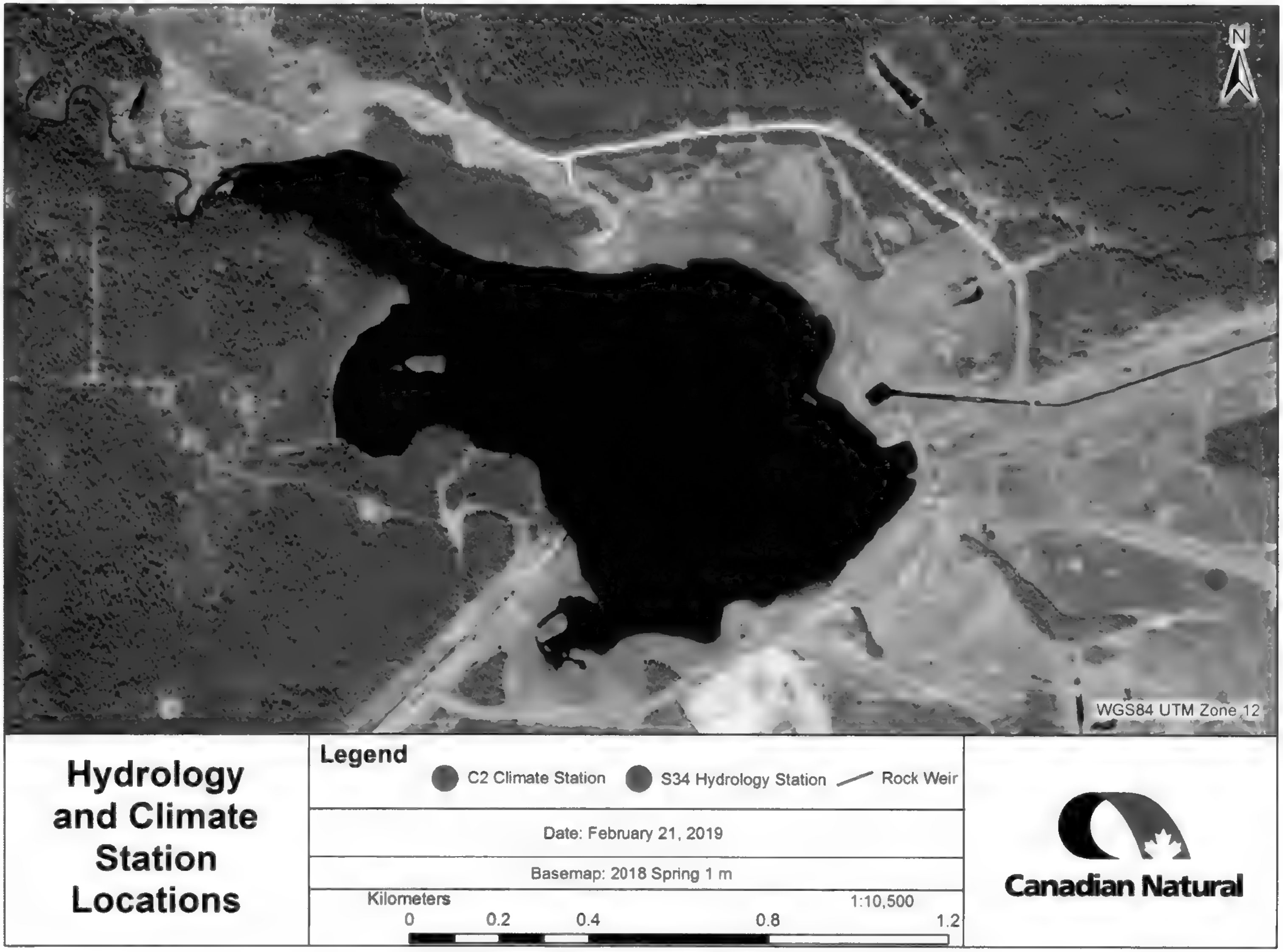

Figure 3 Snow Depth at the C2 Climate Station.

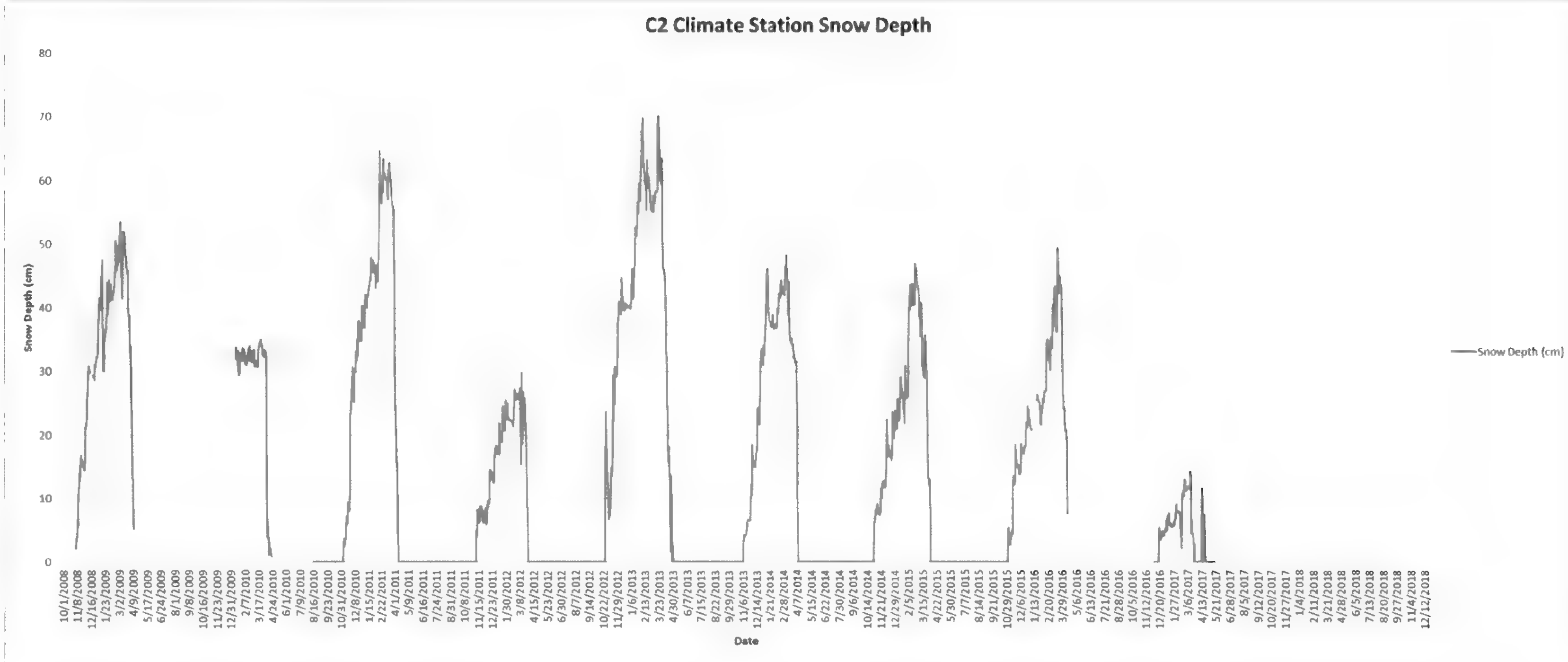

Figure 4 Horizon Lake Water Elevation 2009-2018.

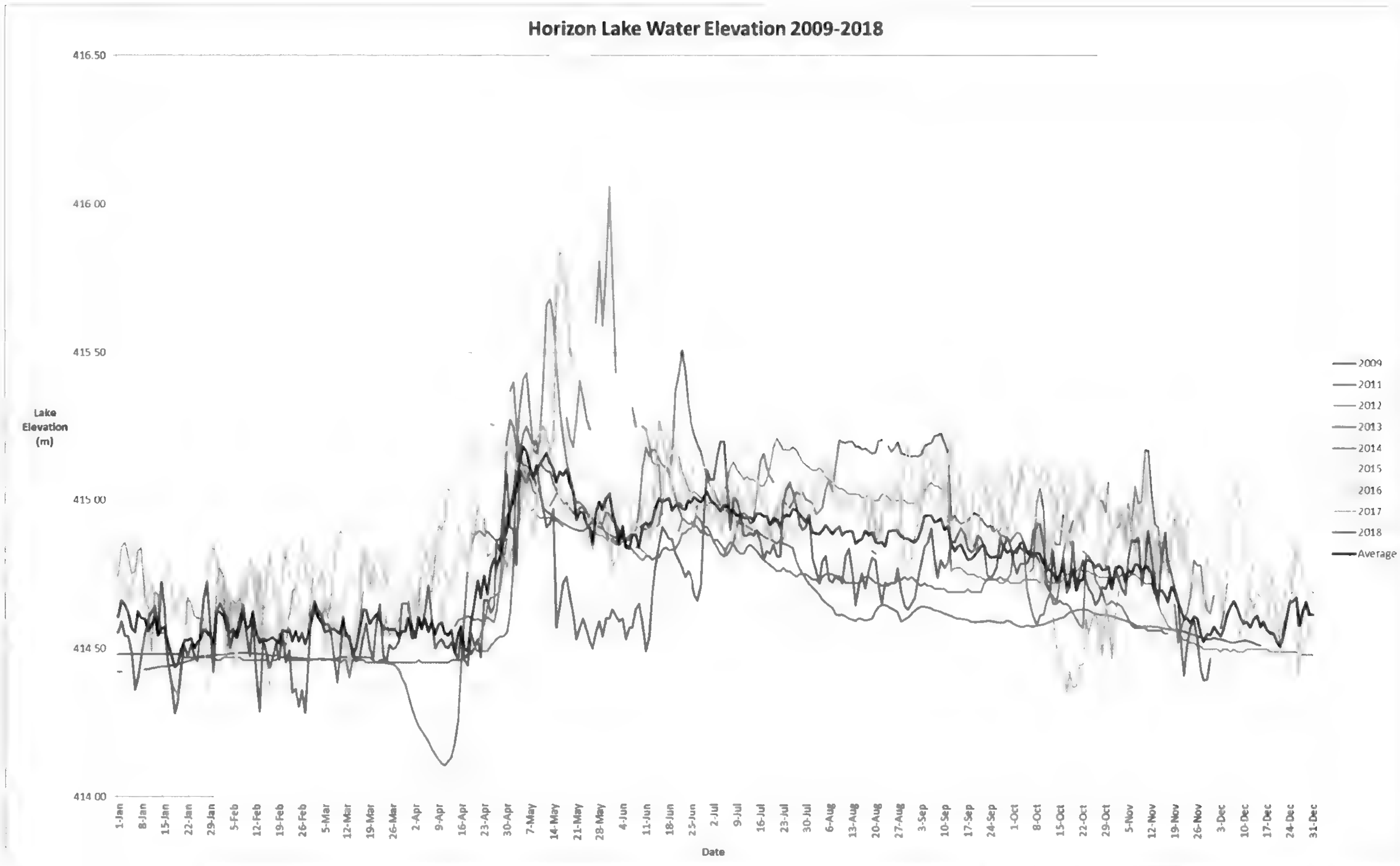

Figure 5 Cumulative Precipitation at C2 Climate Station - Excluding 2009, 2015 and 2017.

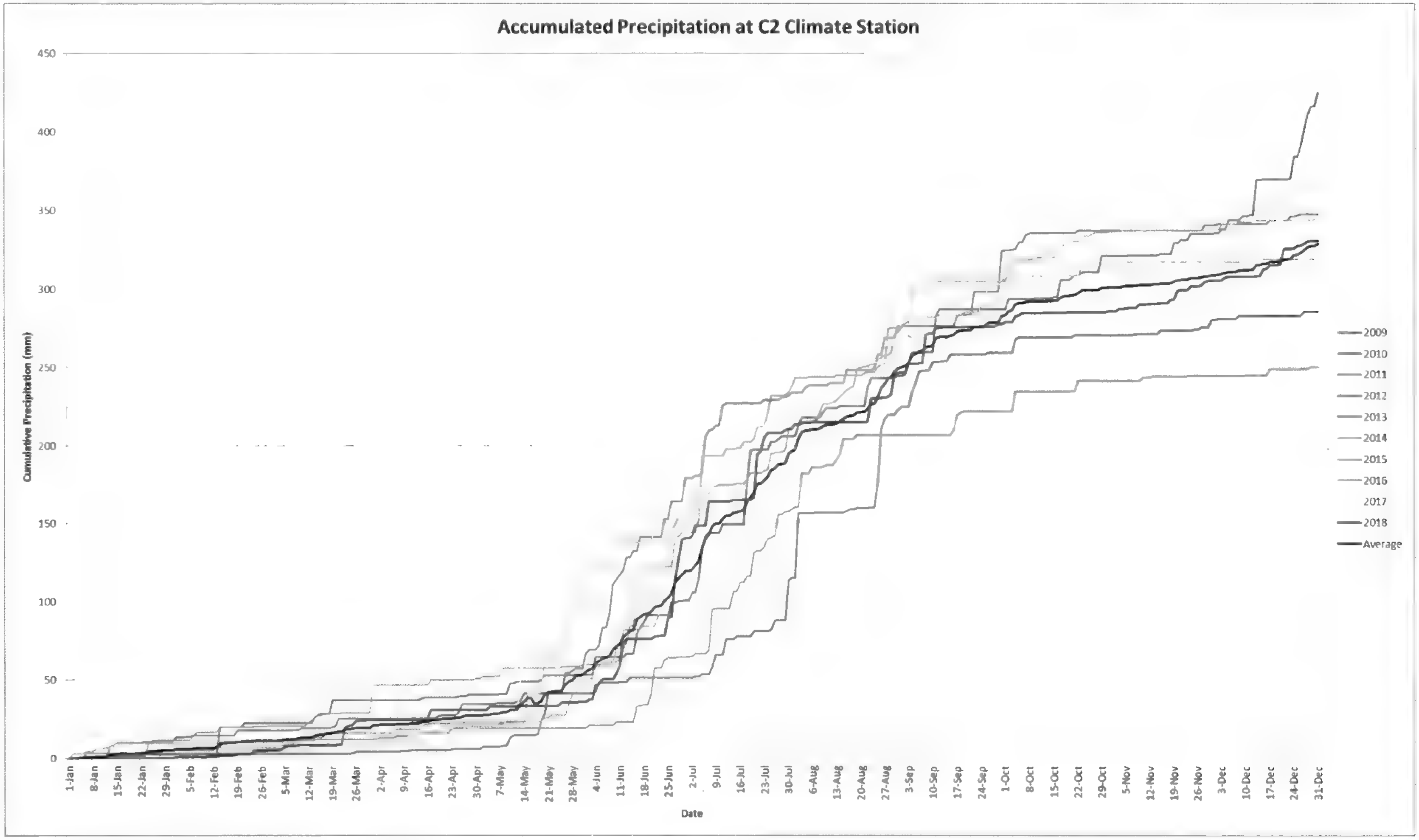

Figure 6 Maximum Discharge at S34 Hydrometric Station at the Tar River (15 minute intervals).

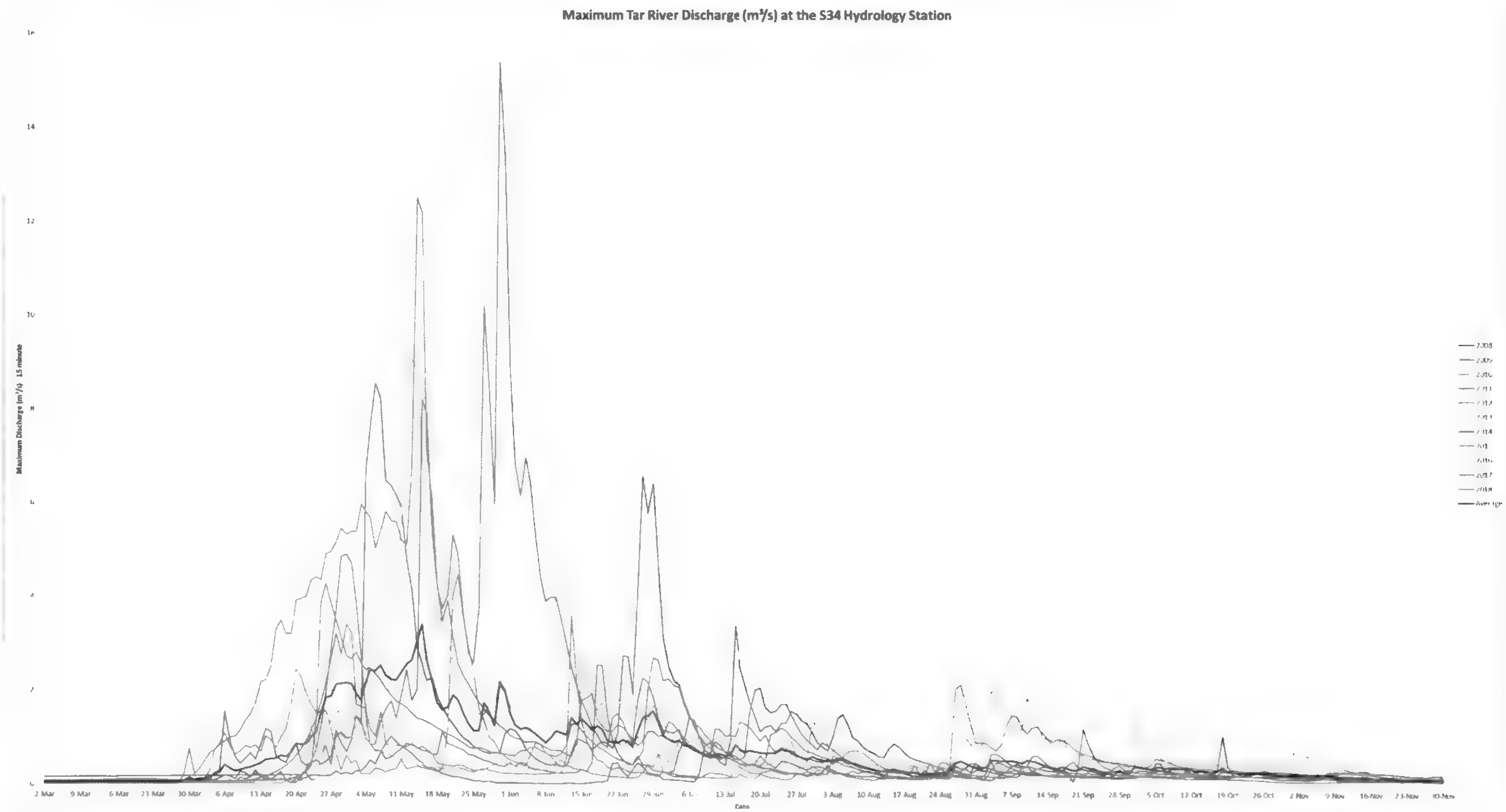

Figure 7 Left Bank Ice and Water Measurements (2013 – 2018).

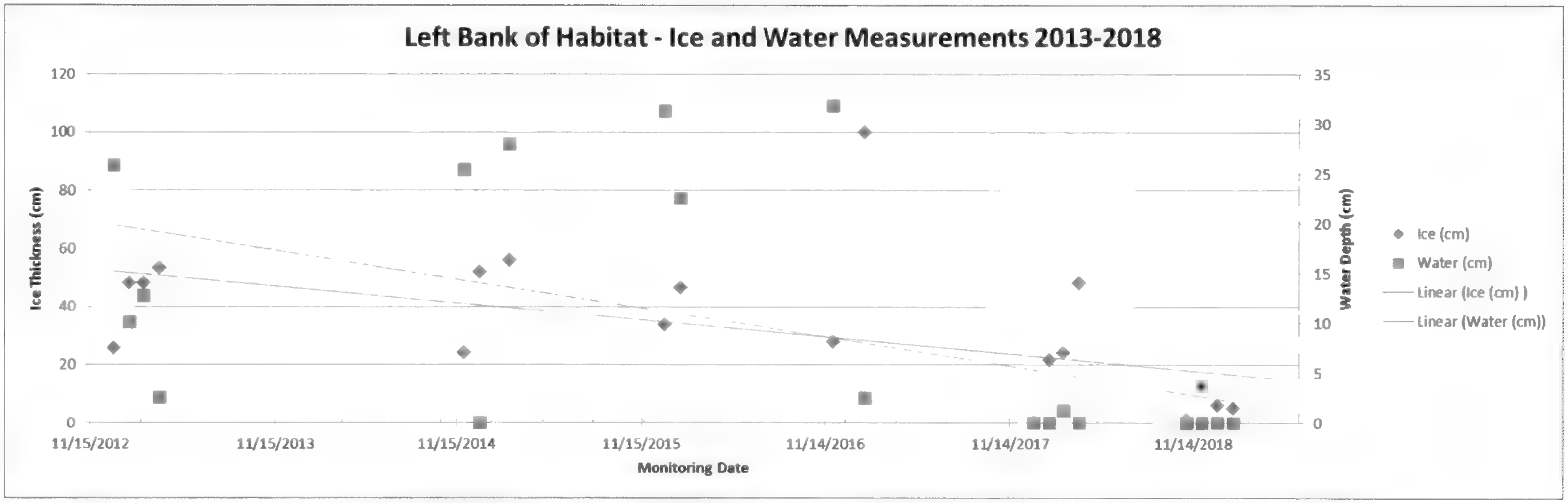

Figure 8 Center Habitat Ice and Water Measurements (2013-2018).

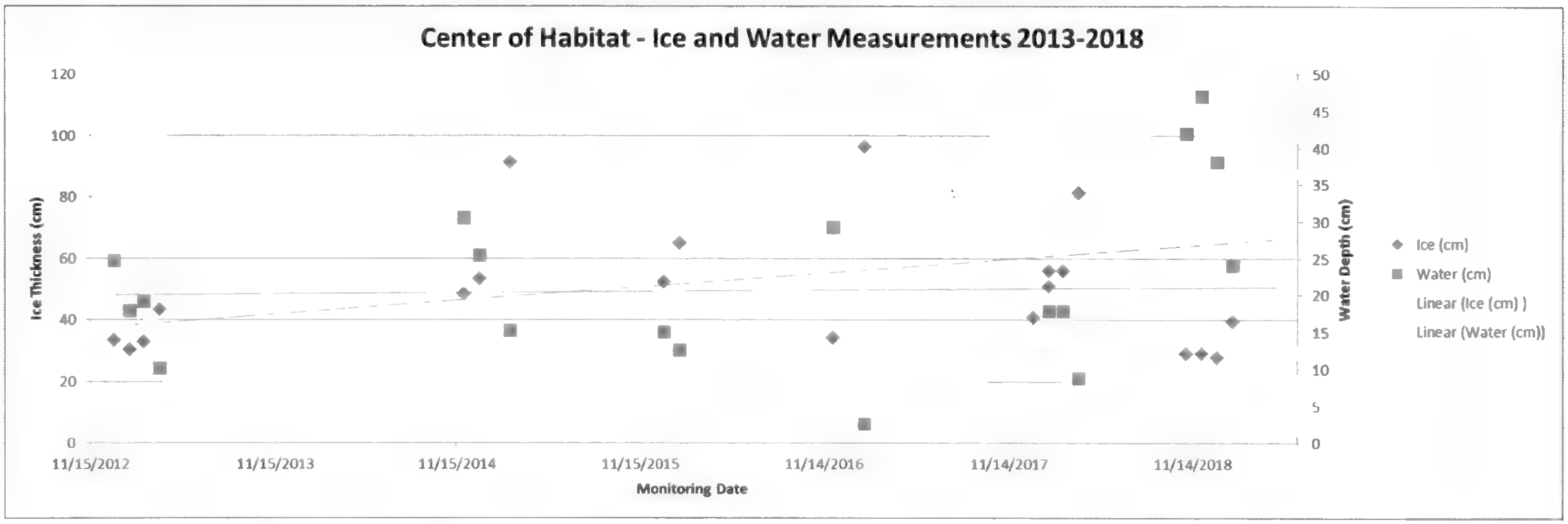

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Figure 9 Right Bank Ice and Water Measurements (2013-2018).

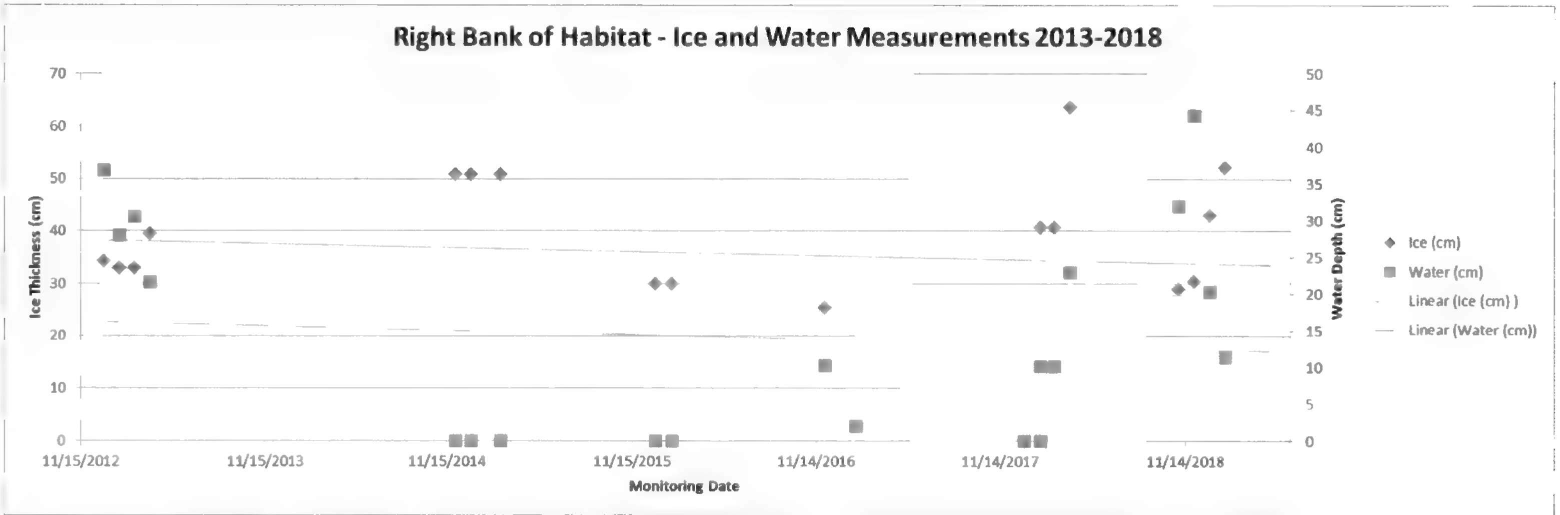

Figure 10 EXO 2 Sonde: Average of temperature data from within the constructed habitat (2013-2018).

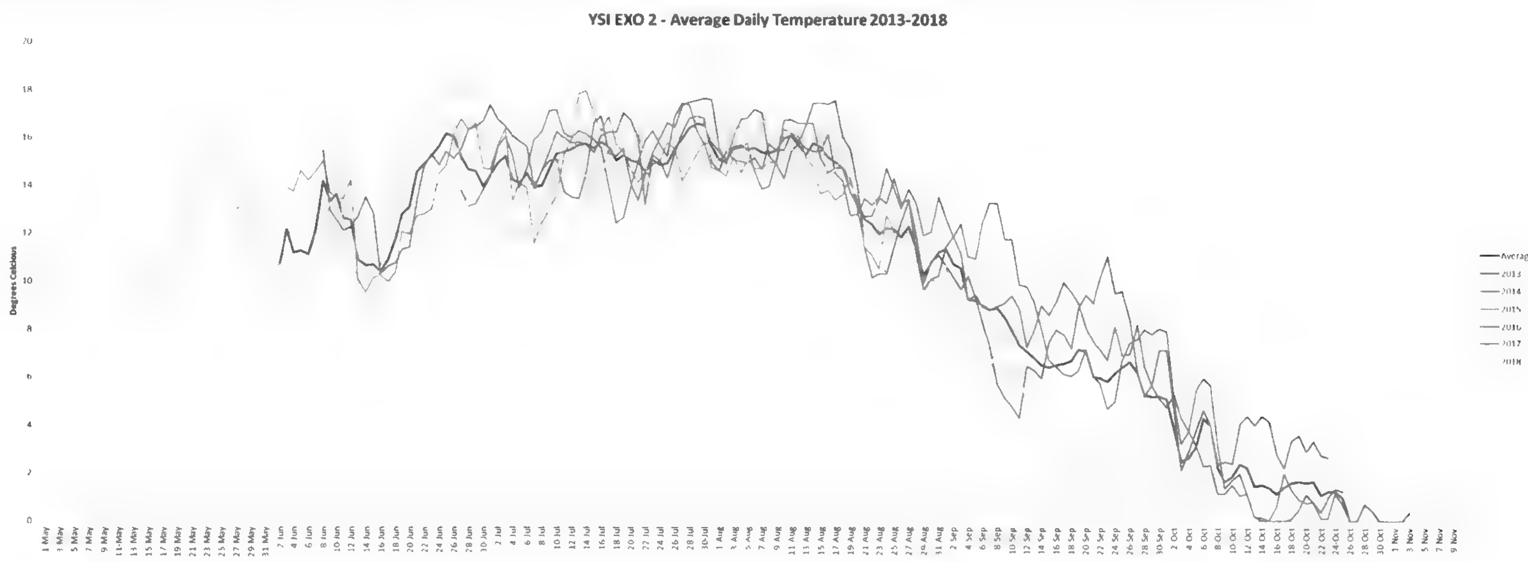

Figure 11 Tar River maximum daily temperature at S34 Hydrometric Station as related to Arctic grayling temperature stressor points.

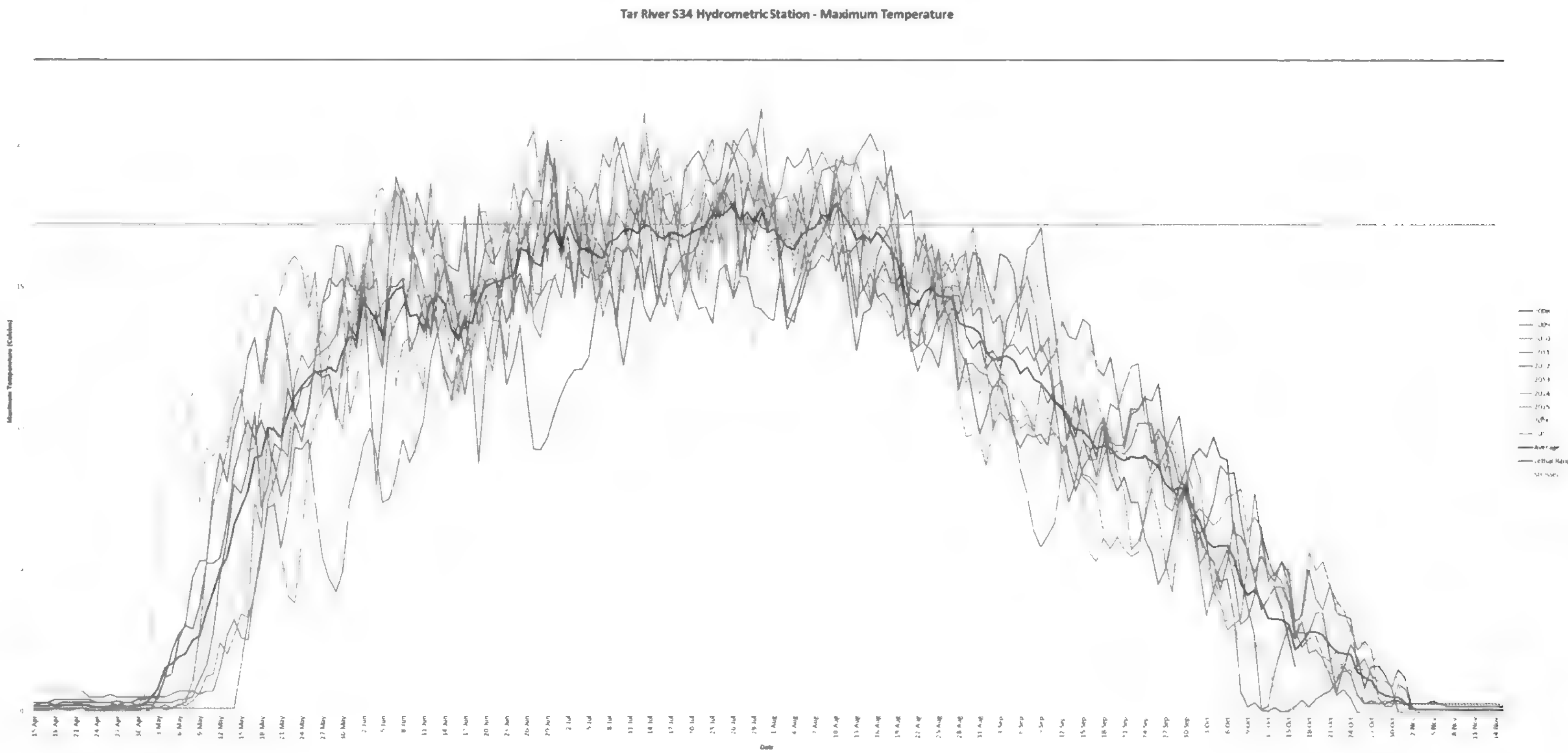

Figure 12 Tar River average daily temperature at S34 Hydrometric Station as related to Arctic grayling temperature stress points.

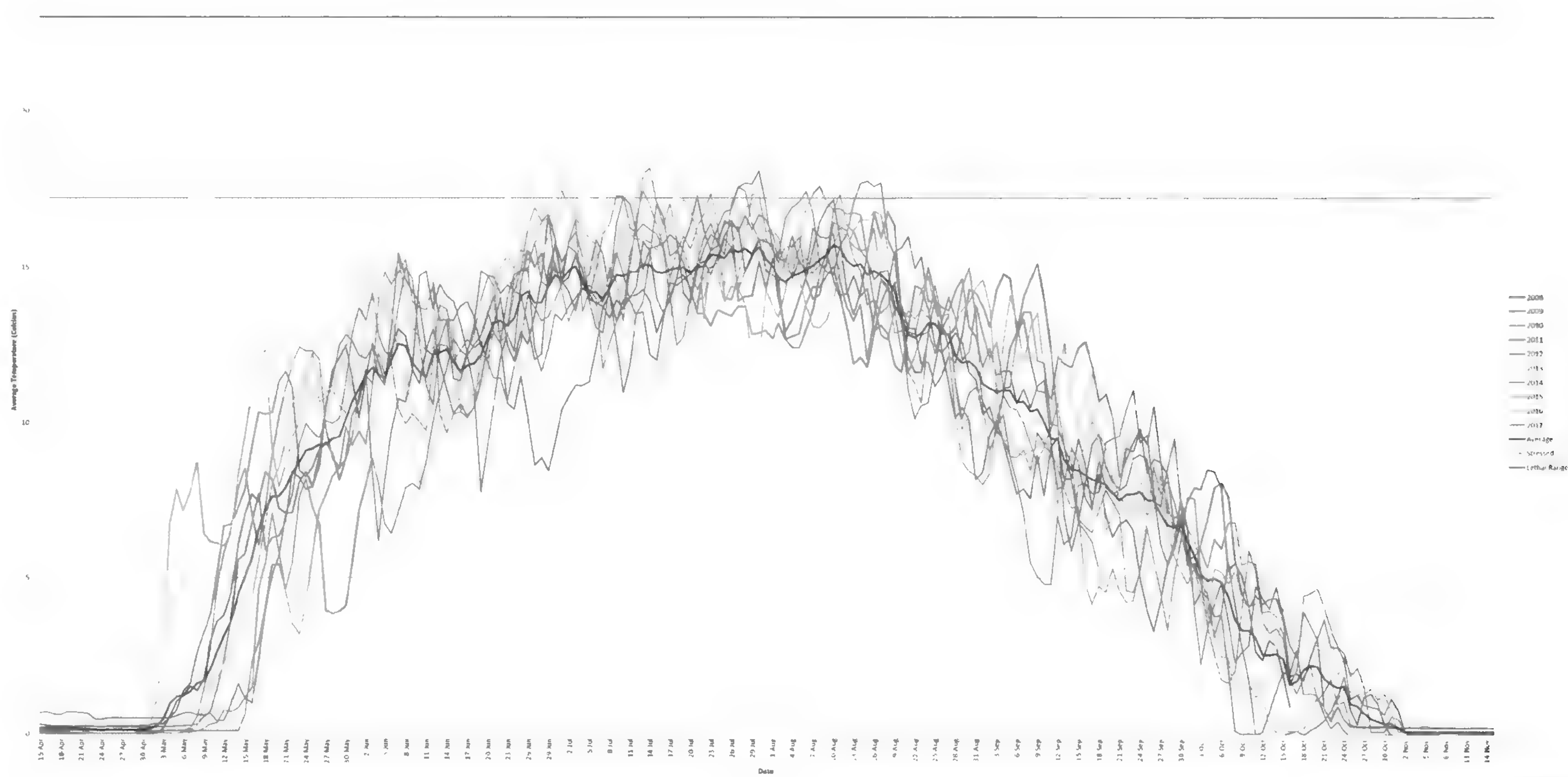

Figure 13 EXO 2 Sonde: Average daily pH from within the constructed habitat (2014-2018).

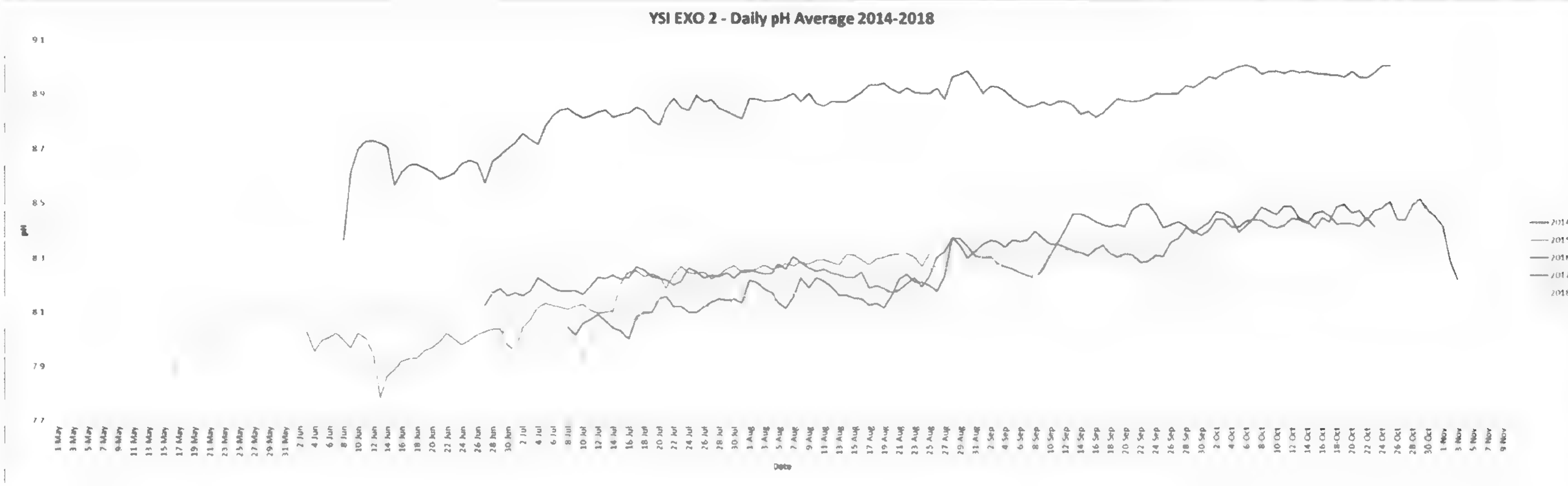

Figure 14 EXO 2: Dissolved Oxygen daily averages in the constructed habitat (2013-2018).

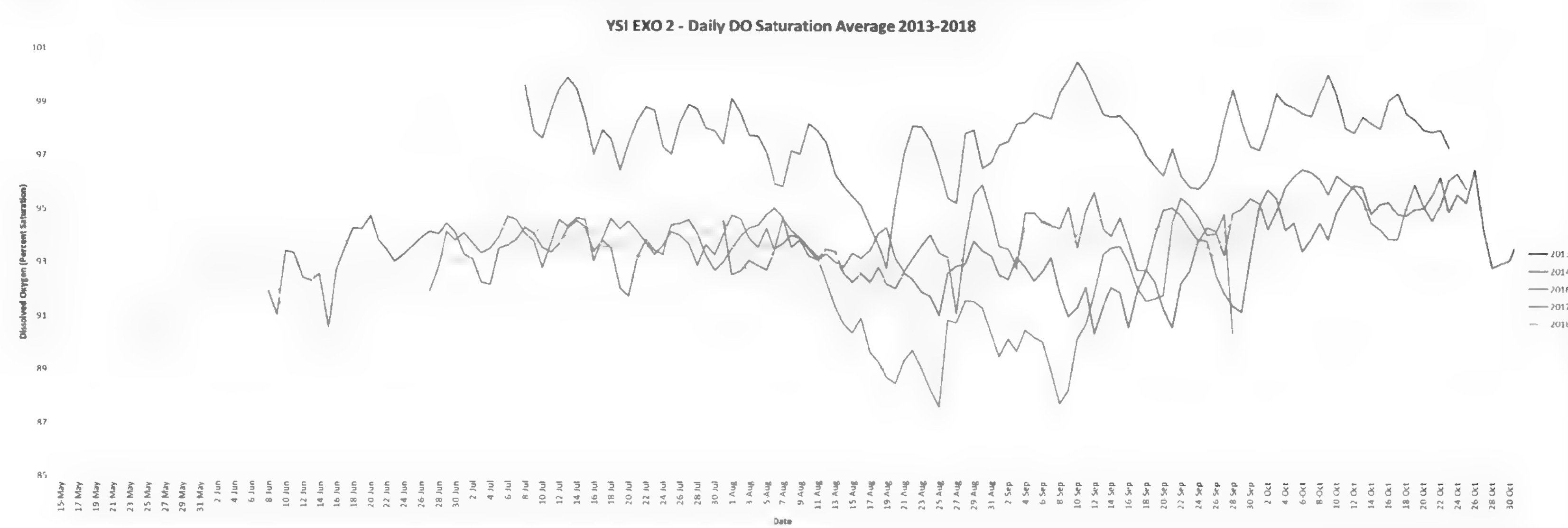

Figure 15 EXO 2: Average daily specific conductivity in the constructed habitat (2013-2018).

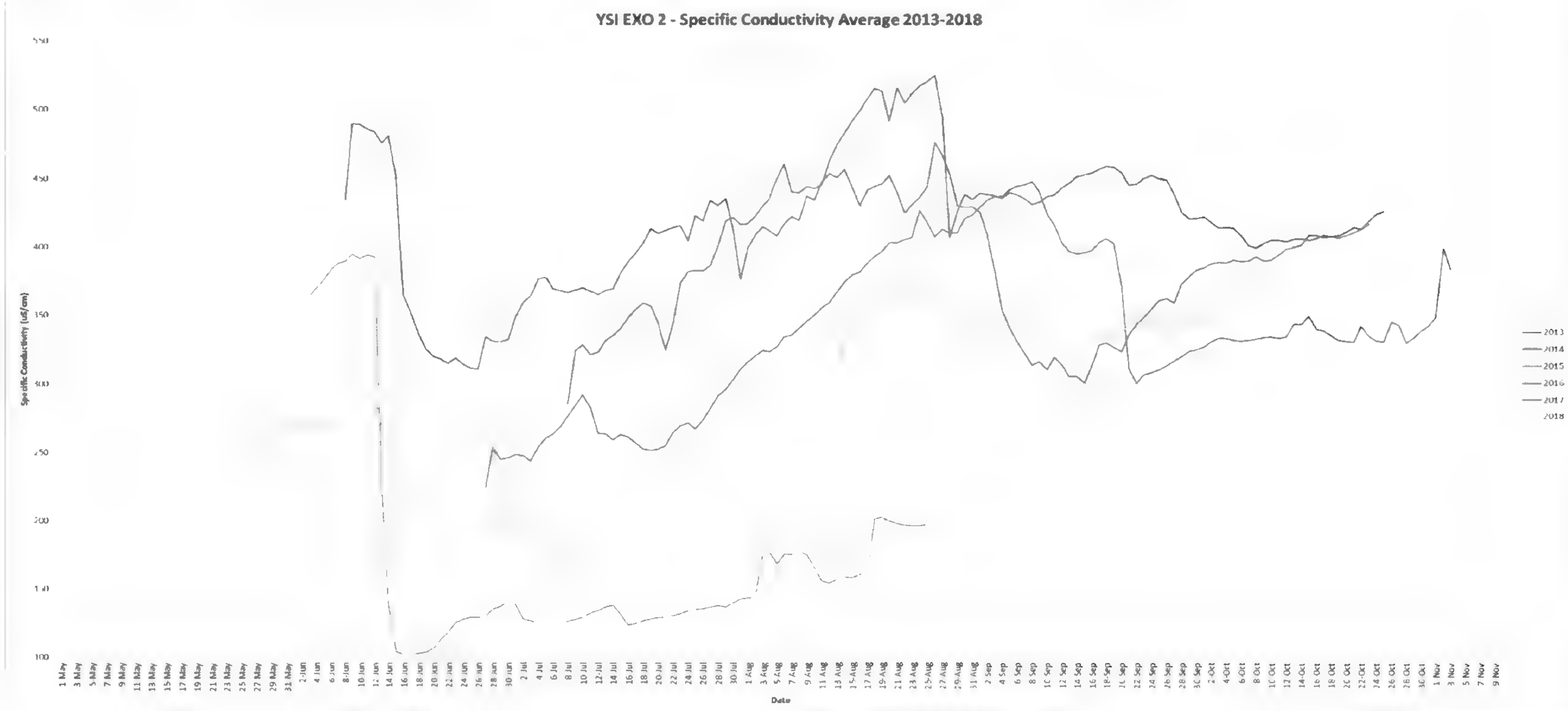

Figure 16 Average monthly open water depth upstream and downstream of the constructed habitat (2013-2018).

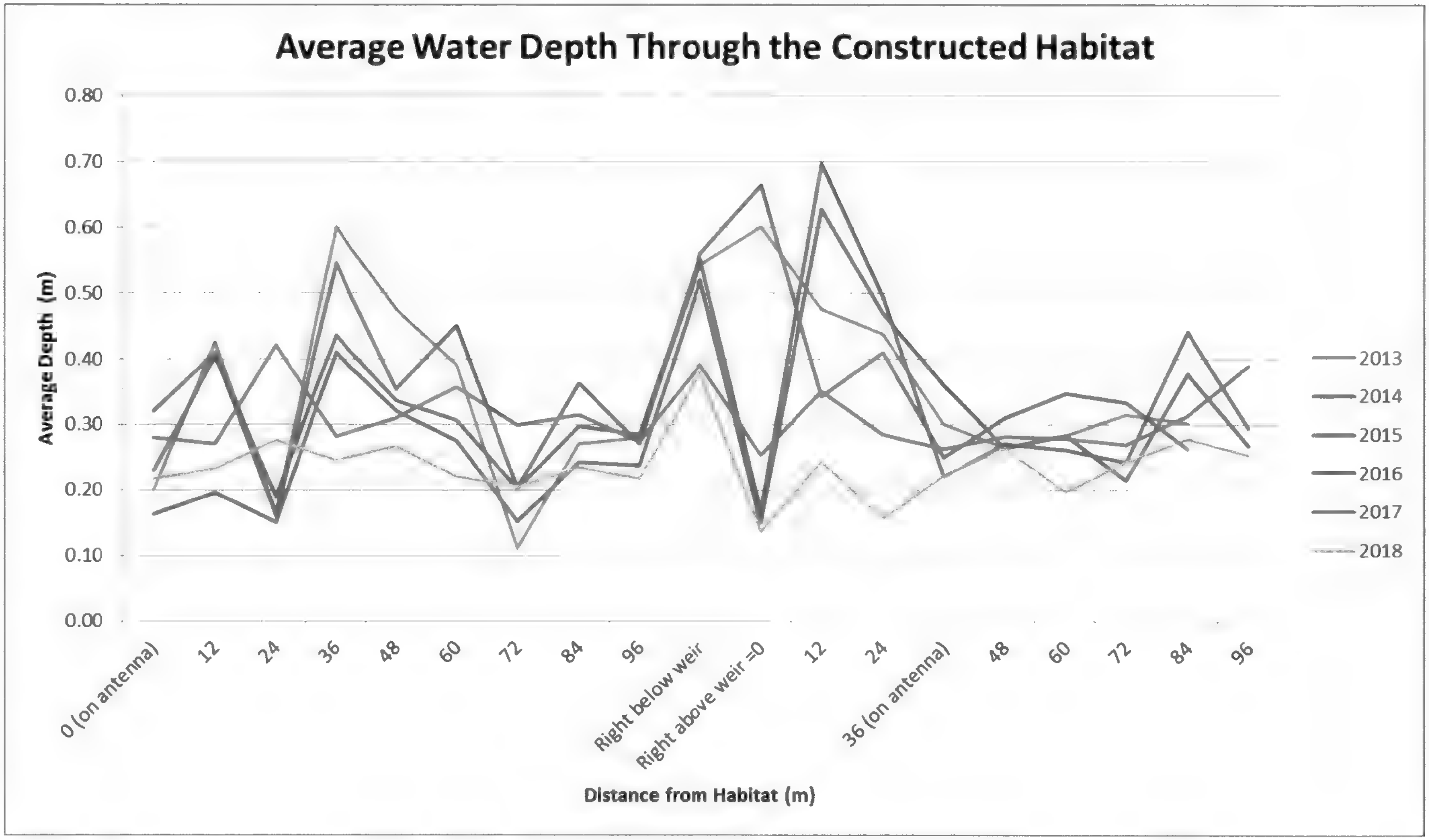

Figure 17 Average monthly open water velocity upstream and downstream of the constructed habitat (2013-2018).

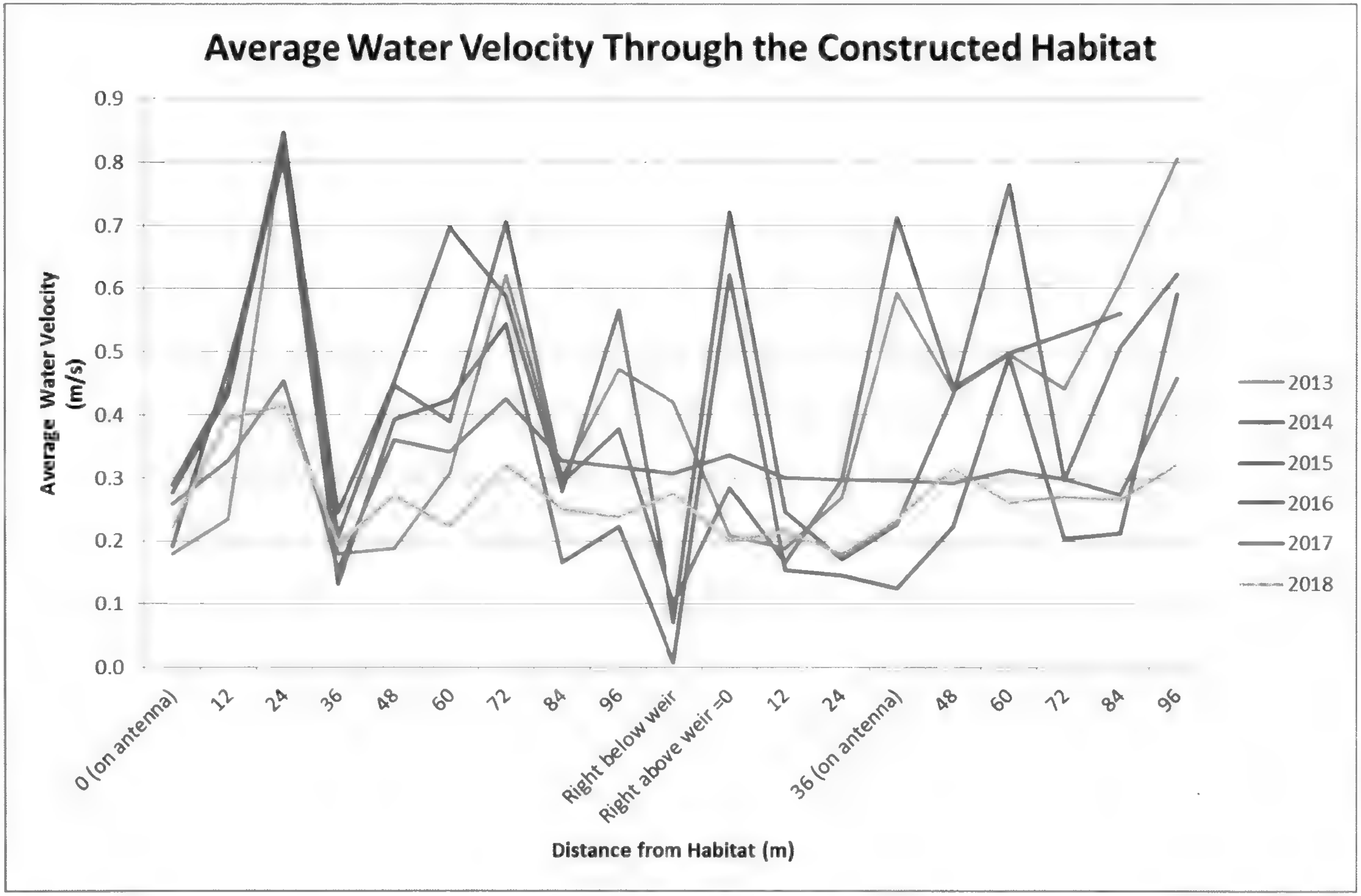

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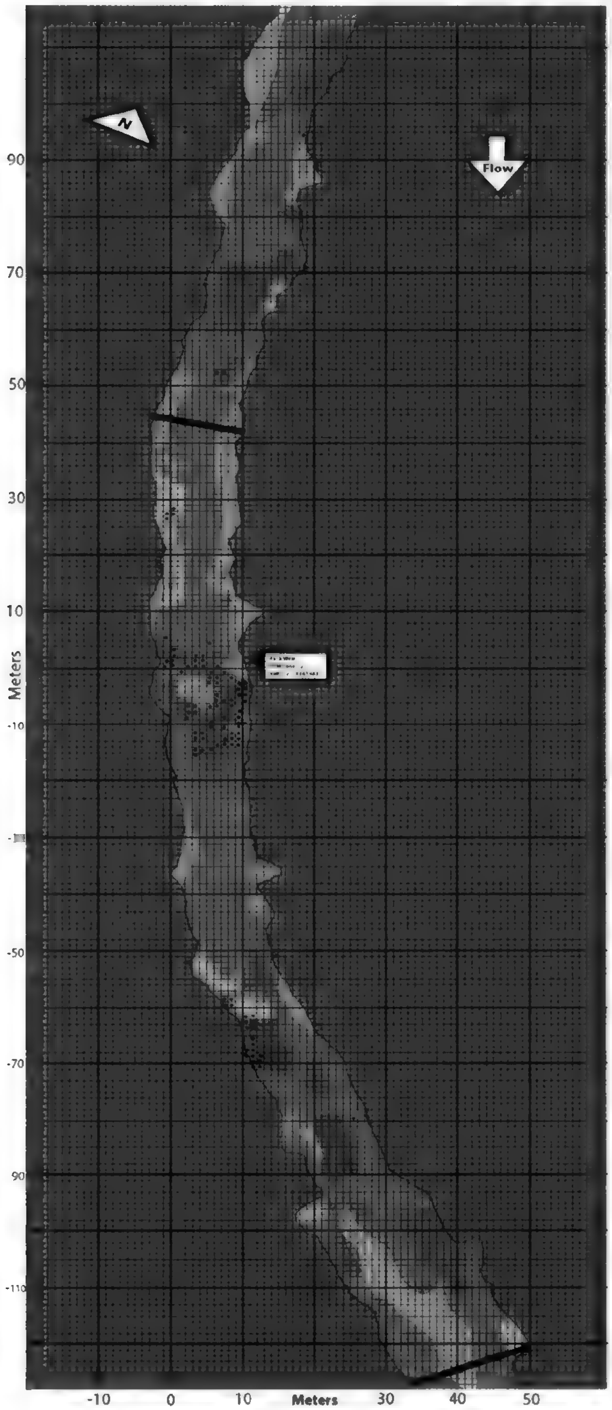
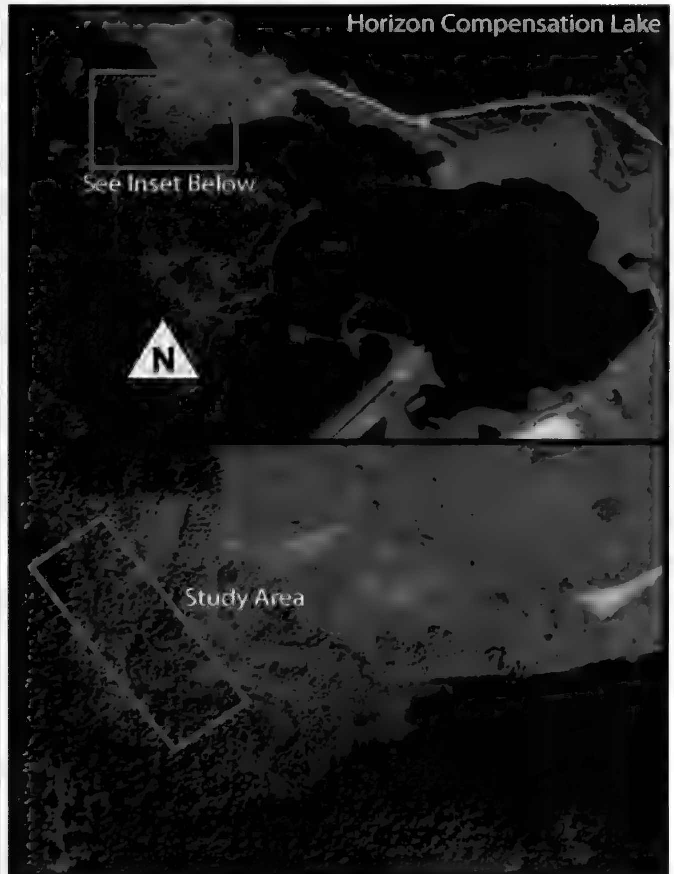
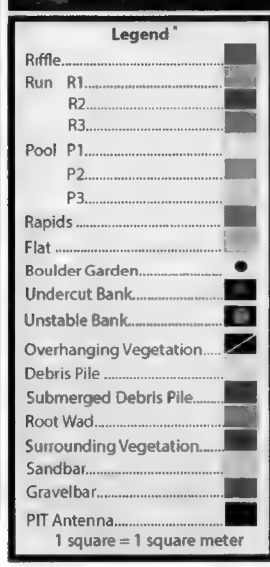
Figure 18 2018 Tar River Fish Compensation Habitat Assessment.

Canadian Natural Resources Limited
Fish Habitat Compensation Map, August 2018

Canadian Natural







Habitat Area and Proportions

		Area (m²)	Proportion
Riffle		376	14 53
Run	R1	0	0.00
	R2	92	3.55
	R3	1554	60 04
Run Total		**1646**	**63.60**
Pool	P1	0	0
	P2	[illegible]	2.05
	P3	114.5	4.42
Pool Total		**167.5**	**6.47**
Rapids		[illegible]	0 70
Flat		154.75	5.98
Submerged Debris Pile		126	4 87
Back Water		2	0.08
Riffle-Boulder Garden		[illegible]	1.35
Rapid-Boulder Garden		21	0.81
R2-Boulder Garden		5	0.19
R3-Boulder Garden		16	0.62
P3-Boulder Garden		8	0.31
Submerged Debris Pile-BG		7	0.27
Flat/Boulder Garden		4	0 15
Back Water Boulder Garden		2	0 08
Total Area		**2588.25**	**100**
Gravel Bar		92.5	-
Sand Bar		424 5	-
Undercut Bank		117	-
Overhanging Vegetation		577	-
Debris Pile		207	-
Root Wad		5	-
Instream Cover		**391.5**	**15.13**
Overhead Cover		**906**	**35.00**

Overhead Cover consists of Root Wad, Undercut Bank, Overhead Vegetation and Debris Pile
Instream Cover consists of Submerged Debris, Boulder Gardens and Pool Habitats
*Definitions for watercourse terms are available in Fish Habitat Manual - Guidelines and Procedures for Watercourse Crossings in Alberta - Sections 4.2.1
~ Boulder Garden (BG) is shown in association with Habitat Type

Table 1 Fish Habitat Manual Table 4-2.

Table 4-2 Small River or Stream Habitat Classification and Rating System
(Adapted from R.L.& L. 1994 and Hawkins et al. 1993)

Channel Unit	Type	Class	Map Symbol	Description
Falls			FA	Highest water velocity; involves water falling over a vertical drop; impassable to fish
Cascade			CA	Extremely high gradient and velocity; extremely turbulent with entire water surface broken; may have short vertical sections, but overall is passable to fish; armoured substrate; may be assoc. with chute (RA/CH)
Chute			CH	Area of channel constriction, usually due to bedrock intrusions; associated with channel deepening and increased velocity
Rapids			RA	Extremely high velocity; deeper than riffle; substrate extremely coarse (large cobble/boulder); instream cover in pocket eddies and associated with substrate
Riffle			RF	High velocity/gradient relative to run habitat; surface broken due to submerged or exposed bed material; shallow relative to other channel units; coarse substrate; usually limited instream or overhead cover for juvenile or adult fish (generally ≤0.5m deep)
Run (glide)			R	Moderate to high velocity; surface largely unbroken; usually deeper than RF; substrate size dependent on hydraulics
	Depth/ Velocity			Run habitat can be differentiated into one of 4 types: deep/slow, deep/fast shallow/slow, or shallow/fast
		1	R1	Highest quality/deepest run habitat; generally deep/slow type; coarse substrate; high instream cover from substrate and/or depth (generally >1.0 m deep)
		2	R2	Moderate quality/depth; high-mod instream cover except at low flow; generally deep/fast or moderately deep/slow type (generally 0.75-1.0m deep)
		3	R3	Lowest quality/depth; generally shallow/slow or shallow/fast type; low instream cover in all but high flows (generally 0.5-0.75m deep)
Flat			FL	Area characterized by low velocity and near-uniform flow; differentiated from pool habitat by high channel uniformity; more depositional than R3 habitat
Pool			P	Discrete portion of channel featuring increased depth and reduced velocity relative to riffle/run habitats; formed by channel scour
		1	P1	Highest quality pool habitat based on size and depth; high instream cover due to instream features and depth; suitable holding water for adults and for overwintering (generally >1.5m deep)
		2	P2	Moderate quality; shallower than P1 with high-mod instream cover except during low flow conditions, not suitable for overwintering
		3	P3	Low quality pool habitat; shallow and/or small; low instream cover at all but high flow events
Impoundment		1-3	IP (1-3)	Includes pools which are formed behind dams; tend to accumulate sediment /organic debris more than scour pools; may have cover associated with damming structure; identify as Class 1, 2 or 3 as for scour pools
	Dam			Three types of impoundments are based on dam type; debris, beaver and landslide
Backwater			BW	Discrete, localized area of variable size exhibiting reverse flow direction; generally produced by bank irregularities; velocities variable but generally lower than main flow; substrate similar to adjacent channel with higher percentage of fines
Snye			SN	Discrete section of non-flowing water connected to a flowing channel only at its downstream end; generally formed in a side-channel or behind a peninsula
Boulder Garden			BG	Significant occurrence of large boulders providing significant instream cover; always in association with an overall channel unit such as a riffle (RF/BG) or run (e.g., R1/BG)

Table 1 (Cont'd.)

ADDITIONAL HABITAT MAPPING SYMBOLS

Feature	Abbr.	Symbol	Description
Ledge	LE		Area of bedrock intrusion into the channel; often associated with chute or plunge pool habitat, may have a vertical drop affecting fish passage
Overhead Cover	OHC		Area of extensive or high quality overhead cover
Instream Cover	ISC		Area of high quality instream cover (velocity shelter) for all life stages
Undercut Bank	UCB		Area of extensive/high quality undercut bank providing overhead cover
Unstable Bank	USB		Area of unstable bank with potential to collapse instream, affecting instream habitat or producing sedimentation
Overhanging Vegetation	OHV		Area of high quality overhanging vegetation providing overhead cover and stream shading
Inundated Vegetation	INV		Area of inundated vegetation; either submergent macrophytes or flooded terrestrial
Debris Pile	DP		Debris pile (e.g., log jam) which influences instream habitat; include effect on cover
Root Wad	RW		Fallen terrestrial vegetation large enough to provide cover for fish
Beaver Dam	BD	XX	Include effect on fish passage

Table 2 Tar River Habitat Type Analysis and Change Comparison.

Habitat Type	Percent Composition						Change Comparison		
	2013	2014	2015	2016	2017	2018	2018 Area (m^2)	Change from 2017	Change in Area (m^2)
RF	10.40%	6.70%	21.57%	13.67%	9.55%	14.52%	**376**	↑	**191.2**
R1	0.00%	0.00%	3.66%	0.43%	0.93%	0.00%	0	↓	18
R2	0.40%	0.80%	10.82%	6.90%	8.47%	3.55%	92	↓	71.9
R3	1.40%	15.30%	52.37%	65.13%	59.12%	60.04%	1554	↑	410.5
Run Total	**1.80%**	**16.10%**	**66.85%**	**72.46%**	**75.77%**	**63.59%**	**1646**	↑	**320.6**
P1	0.90%	0.00%	0.08%	0.00%	0.00%	0.00%	0	-	0
P2	9.20%	0.40%	0.91%	0.32%	2.50%	2.05%	53	↑	4.6
P3	4.90%	9.00%	3.67%	1.57%	2.89%	4.43%	114.55	↑	58.75
Pool Total	**14.90%**	**9.40%**	**4.65%**	**1.95%**	**5.39%**	**6.48%**	**167.5**	↑	**63.3**
Rapids	1.30%	0.70%	2.52%	0.64%	0.54%	0.69%	18	↑	7.5
BW	-	-	-	-	-	-	2	↑	2
Flat	38.80%	32.90%	-	2.77%	5.27%	5.98%	154.75	↑	52.85
SDP	2.70%	4.00%	4.23%	4.35%	6.89%	4.87%	126	↓	7.3
RF-BG	-	-	-	0.16%	0.57%	1.35%	35	↑	24
R2-BG	-	-	-	1.12%	0.78%	0.19%	5	↓	10
R3-BG	-	-	-	1.39%	1.24%	0.62%	16	↓	8
P2-BG	-	-	-	0.00%	0.05%	0.00%	0	-	0
P3-BG	-	-	-	0.05%	0.31%	0.31%	8	↑	1
Rapids-BG	-	-	-	0.96%	0.78%	0.81%	21	↑	6
SDP-BG	-	-	-	0.53%	0.10%	0.27%	7	↑	5
Flat-BG	-	-	-	-	-	-	4	↑	4
BW-BG	-	-	-	-	-	-	2	↑	2
Total-BG	2.80%	2.30%	5.95%	4.21%	3.83%	3.55%			
Total	-	-	-	-	-	-	**2588.25**	-	**654.15**
GB	-	347.25	-	365	138.5	92.5	92.5	↓	46
SB	142	254.5	-	59.95	221.9	424.5	424.5	↑	202.6
UCB	-	-	-	71	75.3	117	117	↑	41.7
OHV	-	-	-	504	284	577	577	↑	293
DP	-	-	-	185	224	207	207	↓	17
RW	-	-	-	12	11.8	5	5	↓	6.8
Overhead Cover	-	-	-	**772**	**617.4**	**906**	**906**	↑	**288.6**
Instream Cover	-	-	-	**197**	**311.5**	**391.5**	**391.5**	↑	**80**
Discharge (m/s)	**0.659**	**0.265**	**0.204**	**0.805**	**0.816**	**0.391**			

Figure 19 Tar River Habitat Map Comparison 2013-2018.

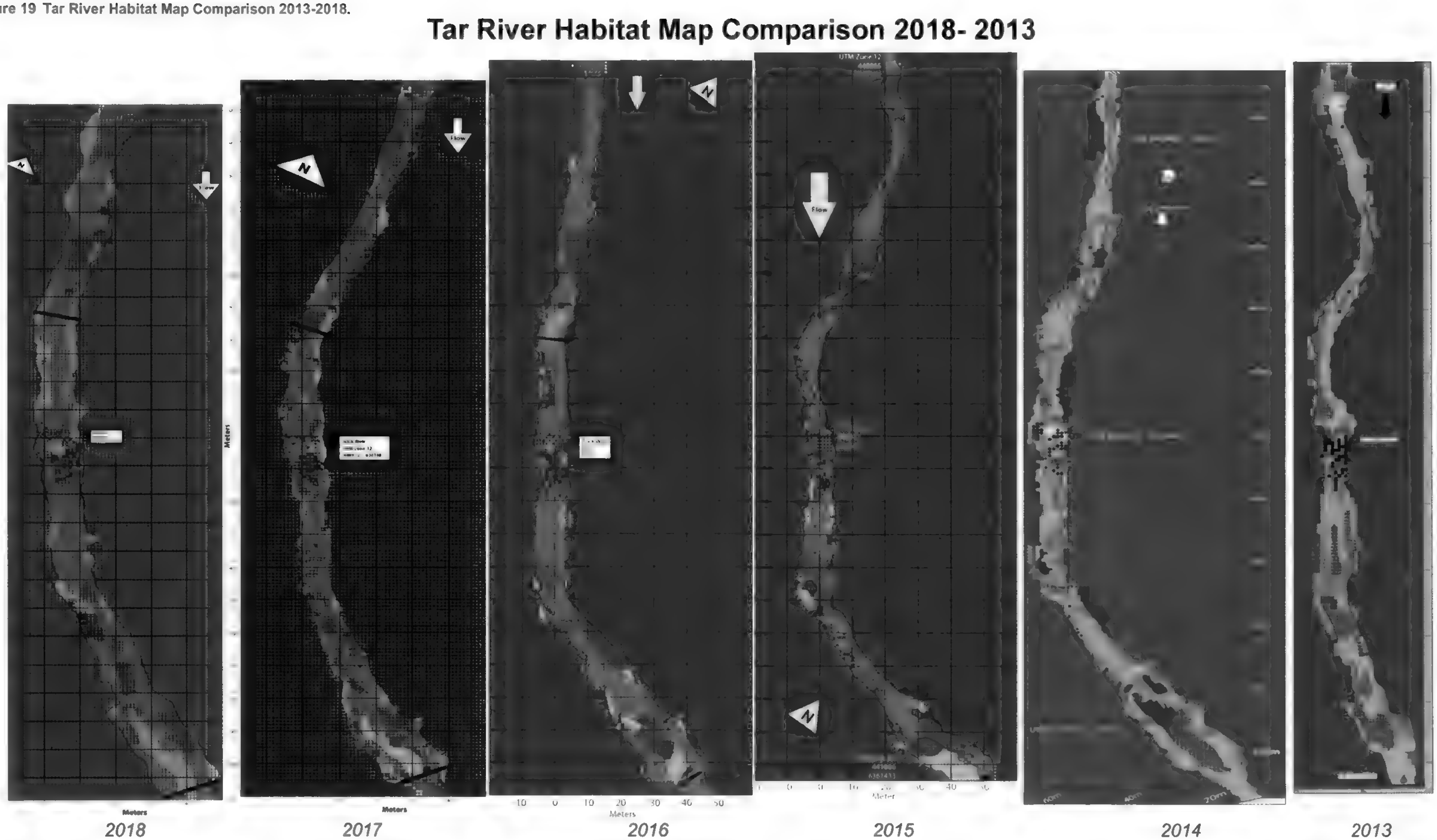


Figure 20 Vegetation Regrowth – East Bank (2018-07-09).

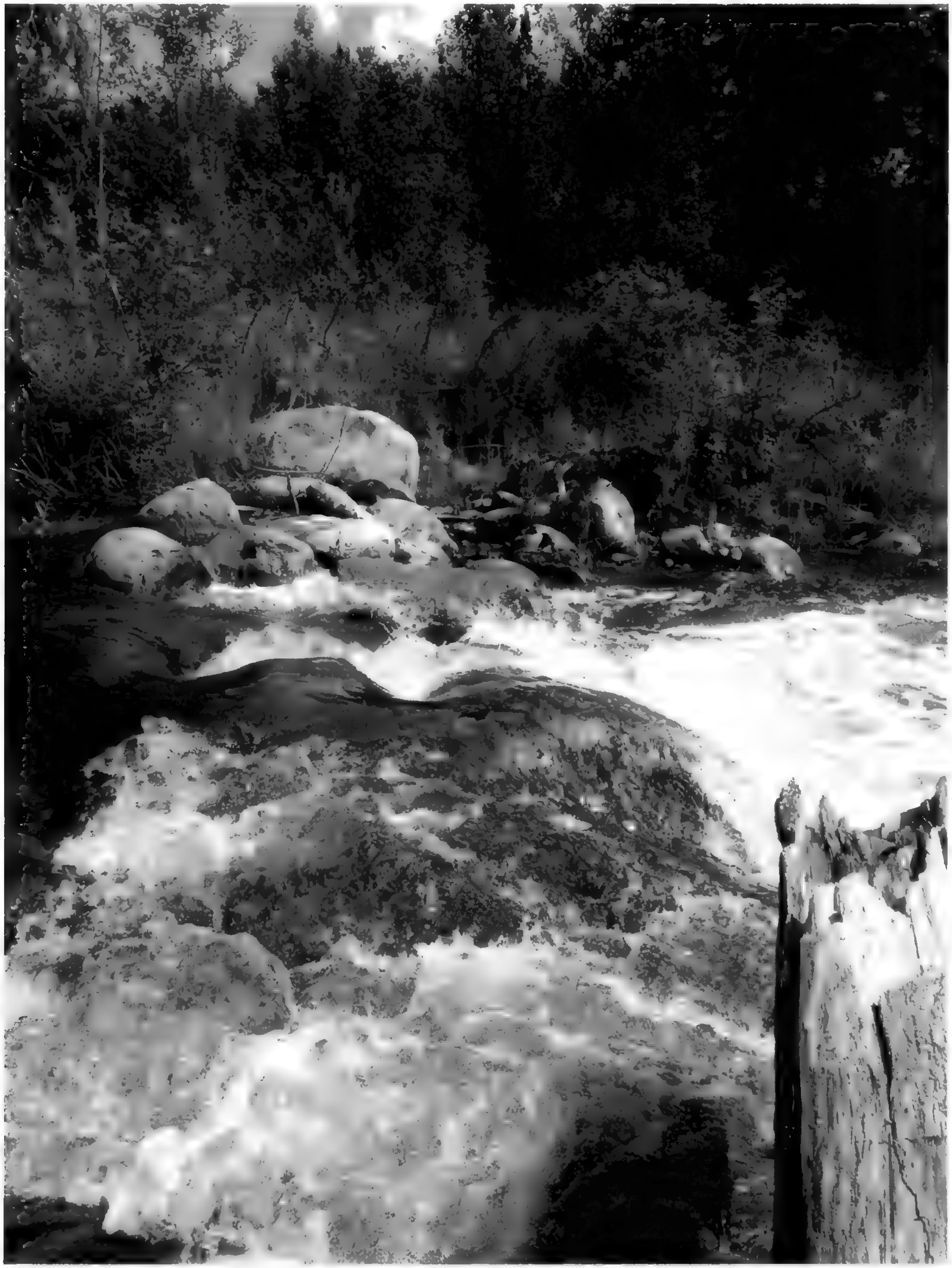


Figure 21 Vegetation Regrowth - West Bank (2018-08-14).

Figure 22 Vegetation Regrowth – East Bank (2018-07-18).

Figure 23 Vegetation Regrowth (2018-07-30).

Figure 24 Overwintering Monitoring Locations.

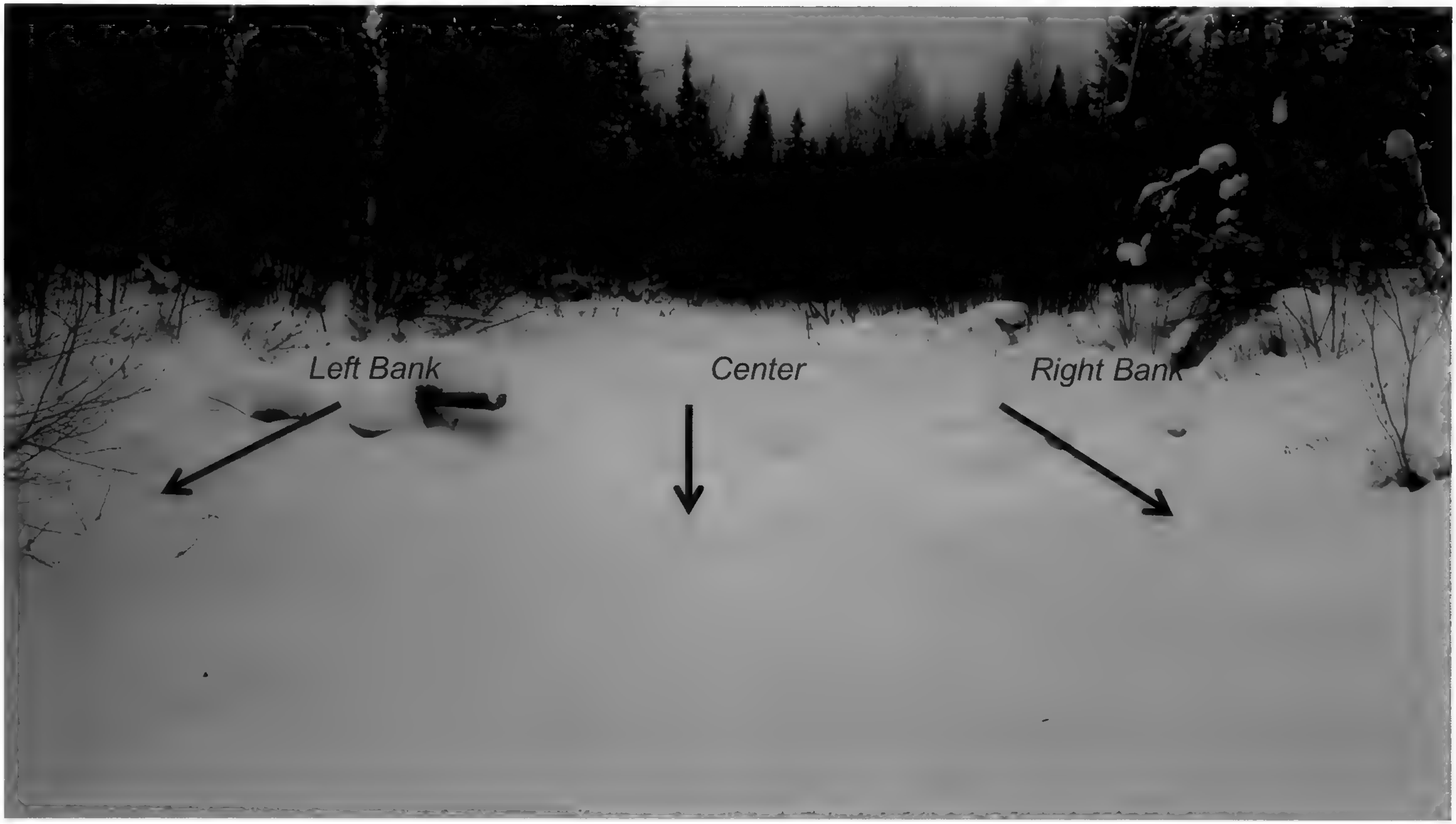


Figure 25 Tar River discharge at ~2.72 m^3/s on April 30, 2018.

Table 3 Total number of fish caught on the upper Tar River, 2018.

Species	Location Relative to the Upper Tar Enhancement Habitat					Total
	Upstream	Within	Downstream	Downstream / Within	Downstream / Within / Upstream	
ARGR	5	0	0	0	0	5
BRST	30	0	0	3	0	33
FTMN	1,834	3	14	2	0	1,853
LKCH	104	10	33	3	0	150
LNSC	56	0	46	3	0	105
PRDC	1	0	0	4	0	5
SLSC	165	3	58	264	55	545
TRPR	0	1	197	6	1	205
WHSC	51	0	18	1	1	71
Unidentified	8	0	3	2	0	13
Total	2,254	17	369	288	57	2,985

Table 4 Total effort on the upper Tar River, 2018.

Method	Units	Location Relative to the Upper Tar Enhancement Habitat				
		Upstream	Within	Downstream	Downstream / Within	Downstream / Within / Upstream
Angling	hrs	0	0	2.25	0	0
Fyke net	hrs	520	0	64	0	0
Minnow trap	hrs	674	24	0	0	0
E-fishing	secs	569	0	0	3,653	0
Snorkel	# habitat units	50	14	0	0	2

Table 5 Comparison of fishing effort, total number of fish caught, and catch-per-unit-effort (CPUE), 2015 and 2018.

Season	Gear Type	Location Relative to Habitat Enhancement	2015 Effort (hr)	2015 Total Fish	2015 CPUE (fish/hr)	2018 Effort (hr)	2018 Total Fish	2018 CPUE (fish/hr)
Spring	Fyke Net	Upstream	214	41	0.19	397	150	0.38
		Downstream	150	135	0.90	0	0	0
		Within	0	0	0	0	0	0
		Total	**364**	**176**	**0.48**	**397**	**150**	**0.38**
	Minnow trap	Upstream	2,141	1,090	0.51	526	1,903	3.62
		Downstream	2,479	2,299	0.93	0	0	0
		Within	501	498	0.99	0	0	0
		Total	**5,122**	**3,887**	**0.76**	**526**	**1,903**	**3.62**
Summer	E-fishing	Upstream	537	6	1.12	0	0	0
		Downstream	2,258	63	2.79	0	0	0
		Downstream/Within	0	0	0	2,723	178	6.54
		Downstream/Within/Upstream	n/a	53	n/a	0	0	0
		Total	**2,795**	**122**	**4.36**	**2,723**	**178**	**6.54**
Fall	Fyke Net	Upstream	66	173	2.64	21	119	5.67
		Downstream	65	1,163	17.9	22	52	2.36
		Within	0	0	0	0	0	0
		Total	**131**	**1,336**	**10.2**	**43**	**171**	**3.98**

n/a: not available.

Table 6 Comparison of fishing effort, total number of fish caught, and catch-per-unit-effort (CPUE) by species and season, 2015 and 2018.

Season	Method	Species	Above Habitat						Below Habitat						In Habitat					
			2015			2018			2015			2018			2015			2018		
			Effort	# fish	CPUE	Effort	# fish	CPUE	Effort	# fish	CPUE	Effort	# fish	CPUE	Effort	# fish	CPUE	Effort	# fish	CPUE
Spring	Fyke net	ARGR	214	0	0.00	397	4	0.01	150	8	0.05	-	-	-	-	-	-	-	-	-
		FTMN	214	17	0.08	397	39	0.10	150	22	0.15	-	-	-	-	-	-	-	-	-
		FNDC	214	0	0.00	397	0	0.00	150	2	0.01	-	-	-	-	-	-	-	-	-
		LKCH	214	17	0.08	397	18	0.05	150	46	0.31	-	-	-	-	-	-	-	-	-
		LNSC	214	0	0.00	397	51	0.13	150	2	0.01	-	-	-	-	-	-	-	-	-
		SLSC	214	1	0.00	397	0	0.00	150	11	0.07	-	-	-	-	-	-	-	-	-
		TRPR	214	0	0.00	397	0	0.00	150	20	0.13	-	-	-	-	-	-	-	-	-
		WHSC	214	6	0.03	397	38	0.10	150	24	0.16	-	-	-	-	-	-	-	-	-
		Total	**214**	**41**	**0.19**	**397**	**150**	**0.38**	**150**	**135**	**0.90**	-	-	-	-	-	-	-	-	-
	Minnow trap																			
		ARGR	2,141	1	0.00	526	0	0.00	2,479	0	0.00	-	-	-	501	0	0.00	-	-	-
		BRST	2,141	51	0.02	526	30	0.06	2,479	26	0.01	-	-	-	501	27	0.05	-	-	-
		FTMN	2,141	651	0.30	526	1,779	3.38	2,479	615	0.25	-	-	-	501	259	0.52	-	-	-
		FNDC	2,141	7	0.00	526	0	0.00	2,479	0	0.00	-	-	-	501	0	0.00	-	-	-
		LKCH	2,141	363	0.17	526	74	0.14	2,479	778	0.31	-	-	-	501	156	0.31	-	-	-
		LNSC	2,141	0	0.00	526	1	0.00	2,479	1	0.00	-	-	-	501	0	0.00	-	-	-
		NRDC	2,141	1	0.00	526	0	0.00	2,479	0	0.00	-	-	-	501	0	0.00	-	-	-
		SLSC	2,141	12	0.01	526	13	0.02	2,479	23	0.01	-	-	-	501	40	0.08	-	-	-
		TRPR	2,141	4	0.00	526	0	0.00	2,479	853	0.34	-	-	-	501	16	0.03	-	-	-
		WHSC	2,141	0	0.00	526	6	0.01	2,479	3	0.00	-	-	-	501	0	0.00	-	-	-
		Total	2,141	**1,090**	**0.51**	**397**	**1,903**	**4.79**	**150**	**2,299**	**15.33**	-	-	-	501	**498**	**0.99**	-	-	-
Summer	E-fishing	LKCH	537	3	0.56	-	-	-	2,258	7	0.31	-	-	-	-	-	-	-	-	-
		LNSC	537	1	0.19	-	-	-	2,258	45	1.99	-	-	-	-	-	-	-	-	-
		SLSC	537	2	0.37	-	-	-	2,258	7	0.31	-	-	-	-	-	-	-	-	-
		TRPR	537	0	0.00	-	-	-	2,258	4	0.18	-	-	-	-	-	-	-	-	-
		Total	537	**6**	**1.12**	-	-	-	2,258	**63**	**2.79**	-	-	-	-	-	-	-	-	-
Fall	Fyke net	ARGR	66	0	0.00	21	0	0.00	65	18	0.28	22	0	0.00	-	-	-	-	-	-
		BRST	66	0	0.00	21	0	0.00	65	2	0.03	22	0	0.00	-	-	-	-	-	-
		FTMN	66	0	0.00	21	0	0.00	65	1	0.02	22	1	0.05	-	-	-	-	-	-
		LKCH	66	3	0.05	21	0	0.00	65	176	2.70	22	0	0.00	-	-	-	-	-	-
		LNSC	66	3	0.05	21	3	0.14	65	45	0.69	22	0	0.00	-	-	-	-	-	-
		PRDC	66	0	0.00	21	1	0.05	65	0	0.00	22	0	0.00	-	-	-	-	-	-
		SLSC	66	167	2.55	21	110	5.24	65	919	14.12	22	51	2.32	-	-	-	-	-	-
		sucker family	66	0	0.00	21	0	0.00	65	2	0.03	22	0	0.00	-	-	-	-	-	-
		WHSC	66	0	0.00	21	5	0.24	65	0	0.00	22	0	0.00	-	-	-	-	-	-
		Total	**66**	**173**	**2.64**	21	**119**	**5.67**	**65**	**1163**	**17.87**	**22**	**52**	**2.36**	-	-	-	-	-	-

Table 7 Total number of Arctic grayling captured downstream, within, and upstream of the enhancement habitat in 2015 and 2018.

Sampling Location	Method	Spring		Summer		Fall		Total
		2015	2018	2015	2018	2015	2018	
Upstream of Habitat Enhancement	Angling	-	-	-	-	-	-	-
	E-fishing	-	-	-	-	-	-	-
	Fish fence	-	-	-	-	-	-	-
	Fyke net	-	4	-	1	-	-	5
	Minnow trap	1	-	-	-	-	-	1
	Snorkel	-	-	-	-	-	-	-
	Total	**1**	**4**	**-**	**1**	**-**	**-**	**6**
Downstream of Habitat Enhancement	Angling	-	-	-	-	-	-	-
	E-fishing	-	-	-	-	-	-	-
	Fish Fence	1	-	-	-	-	-	1
	Fyke net	8	-	-	-	18	-	26
	Minnow trap	-	-	-	-	-	-	-
	Snorkel	-	-	-	-	-	-	-
	Total	**9**	**-**	**-**	**-**	**18**	**-**	**27**
Within Habitat Enhancement	Angling	-	-	-	-	-	-	-
	E-fishing	-	-	-	-	-	-	-
	Fish Fence	-	-	-	-	-	-	-
	Fyke net	-	-	-	-	-	-	-
	Minnow trap	-	-	-	-	-	-	-
	Snorkel	-	-	-	-	-	-	-
	Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total		**10**	**4**	**-**	**1**	**18**	**-**	**33**

Appendix A3

Photo Documentation

The files for Appendix A3 are provided on DVD-ROM.

Appendix A4

Fish Capture and Fish Tissue Data

Table A4.1 Snorkel Survey data collected on the upper Tar River and Horizon Lake, spring 2018.

					Location				Physical Characteristics						Substrate										
Date	Watercourse	Habitat Unit	Start Time	End Time	Downstream/ Start UTM E	Downstream/ Start UTM N	Upstream/ End UTM E	Upstream/ End UTM N	Habitat Type	Wetted width (m)	Max depth (m)	Mean depth (m)	Visibility (m)	Flow (m/s; at 50% width, 60% depth)	Organics (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Macrophyte cover (%)	Fish presence/ Spawning Indicators	Comments
29-May-18	Tar River	HU1	9:10	9:36	441085	6361343	441049	6361332	Run/Pool	10-16	1	0.2	0.8	0.135	-	5	5	90	-	-	-	-	Trace	-	Large woody debris on RDB from old dam. Trace macrophytes (Horsetail)
29-May-18	Tar River	HU2	9:36	9:43	441049	6361332	441056	6361381	Run/Pool	10	0.4	0.2	-	0.228	-	5	5	90	-	-	-	-	-	-	Some large and small woody debris on RDB
29-May-18	Tar River	HU3	9:43	9:57	441056	6361381	441033	6361426	Run/Pool	6-16	0.8	0.4	-	0.172	10	2.5	2.5	85	-	-	-	-	-	-	Large woody debris on LDB. Otter or beaver observed
29-May-18	Tar River	HU4	9:57	10:07	441033	6361426	440990	6361430	Run	8-15	0.3	0.2	-	0.4	-	-	20	20	50	5	5	-	-	White/Transluscent eggs in channel on right bank of island approx. 2mm diameter - in cobble	Large woody debris on RDB. Sandbar in middle of channel.
29-May-18	Tar River	HU5 - RDB	10:07	10:16	440990	6361430	440979	6361436	Riffle	4	0.4	0.2	-	0.416	-	-	-	-	10	90	-	-	-	-	Small and large woody debris on RDB. Both sides of island/sandbar
29-May-18	Tar River	HU5 - LDB	10:07	10:16	440990	6361430	440979	6361436	Riffle	6	0.1	0.075	-	Too shallow for swoffer	-	-	-	-	10	90	-	-	-	Eggs in cobble/gravel	-
29-May-18	Tar River	HU6	10:16	10:33	440979	6361436	440940	6361440	Run	14	0.5	0.4	-	0.136	Trace	-	70	-	-	10	20	-	-	Eggs at D/S end in cobble at top of riffle. Large egg mass under boulder. 3 WHSC observed (1 x 250 mm (A); 2 x 60 mm (J)). Healthy adult still plump	Photos
29-May-18	Tar River	HU7	10:33	10:36	440940	6361440	440929	6361454	Riffle/Run	16	0.3	0.2	-	0.177	5	-	5	-	20	70	-	-	-	-	Thick periphyton.
29-May-18	Tar River	HU8	10:36	10:43	440929	6361454	440917	6361488	Run	-	0.6	0.3	-	0.061	-	-	5	5	-	60	30	-	-	1 WHSC (70 mm)	Below weir. Flow taken mid channel.
29-May-18	Tar River	HU9	11:23	11:28	440917	6361488	440897	6361528	Run	12	0.6	0.3	-	-	-	-	2.5	2.5	25	60	Trace	-	-	-	Above weir. Thick periphyton. Large woody debris on RDB
29-May-18	Tar River	HU10	11:30	11:31	440897	6361528	440894	6361547	Riffle/Run	-	0.3	0.15	-	-	-	-	-	10	10	80	-	-	-	-	Riffle with run on LDB.
29-May-18	Tar River	HU11	11:31	11:34	440894	6361547	440890	6361571	Run	14	0.4	0.3	-	-	-	-	-	40	10	50	-	-	-	-	-
29-May-18	Tar River	HU12	11:34	11:35	440890	6361571	440891	6361576	Riffle	6	0.25	0.15	-	-	-	-	-	-	10	85	5	-	-	-	-
29-May-18	Tar River	HU13	11:35	11:36	440891	6361576	440884	6361587	Run	8	0.3	0.25	-	-	-	-	-	30	20	50	-	-	-	-	-
29-May-18	Tar River	HU14	11:36	11:38	440884	6361587	440869	6361603	Riffle	10	0.2	0.1	-	-	-	-	-	25	20	50	5	-	-	-	Iron leachates in pool on RDB
29-May-18	Tar River	HU15	11:38	11:42	440869	6361603	440859	6361609	Run	5-8	0.4	0.2	-	-	-	-	-	40	-	35	25	-	-	1 small (30 mm) unknown species.	Trichopterans present - very long, woody
29-May-18	Tar River	HU16	11:42	12:01	440859	6361609	440805	6361556	Riffle/Run	12	0.3	0.2	-	-	-	-	-	Trace	20	80	Trace	-	-	-	Riffle with small run between. Small woody debris on LDB and RDB. Lots of sediment loading.
29-May-18	Tar River	HU17	12:01	12:07	440805	6361556	440795	6361540	Run/Pool	10-14	0.8	0.4	-	-	-	-	35	35	10	20	-	-	-	-	Small woody debris across channel
29-May-18	Tar River	HU18	12:07	12:09	440795	6361540	440777	6361537	Riffle	14	0.25	0.1	-	-	-	-	-	-	10	90	-	-	-	-	2° slope.

Table A4.1 (Cont'd.)

Date	Watercourse	Habitat Unit	Start Time	End Time	Location: Downstream/ Start UTM E	Location: Downstream/ Start UTM N	Location: Upstream/ End UTM E	Location: Upstream/ End UTM N	Habitat Type	Physical Characteristics: Wetted width (m)	Max depth (m)	Mean depth (m)	Visibility (m)	Flow (m/s; at 50% width, 60% depth)	Substrate: Organics (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Macrophyte cover (%)	Fish presence/ Spawning Indicators	Comments
29-May-18	Tar River	HU19	12:09	12:30	440777	6361537	440715	6361547	Run	6-16	>1.0	0.4	-	-	-	-	-	60	30	10	Trace	-	-	1 SLSC 60 mm	Semi-constructed beaver dam within unit. Lots of small and large woody debris.
29-May-18	Tar River	HU20	12:30	12:31	440715	6361547	440706	6361556	Riffle	22	0.1	0.1	-	-	-	-	-	10	40	50	-	-	-	-	Exposed gravel bar in middle (17 m). Less periphyton growth
29-May-18	Tar River	HU21	12:31	12:45	440706	6361556	440746	6361643	Run	9	0.4	0.2	-	-	-	-	-	30	50	20	-	-	-	-	Large and small woody, small riffle in middle, large debris crossing river at upstream end.
29-May-18	Tar River	HU22	12:45	12:46	440746	6361643	440740	6361655	Riffle	5	0.2	0.1	-	-	-	-	-	-	20	80	-	-	-	-	Slope 4-5°.
29-May-18	Tar River	HU23	15:03	15:06	440740	6361655	440724	6361672	Run	10	0.5	0.2	-	-	-	-	-	20	40	40	-	-	-	-	-
29-May-18	Tar River	HU24	15:06	15:09	440724	6361672	440707	6361704	Riffle	8	0.15	0.1	-	-	-	-	-	-	25	70	5	-	-	1 unknown species ~ 150 mm	-
29-May-18	Tar River	HU25	15:09	15:27	440707	6361704	440694	6361720	Run	6-18	0.4	0.3	-	-	-	-	-	-	20	80	-	-	-	1 SLSC 80 mm alive; 1 SLSC mort	-
29-May-18	Tar River	HU26	15:27	15:30	440694	6361720	440662	6361715	Riffle	10	0.3	0.2	-	-	-	-	-	Trace	30	60	10	-	-	-	-
29-May-18	Tar River	HU27	15:30	15:37	440662	6361715	440633	6361700	Run	10-12	0.7	0.3	-	-	-	-	-	80	10	10	Trace	-	-	-	Large and small woody debris across channel; some overhanging trees.
29-May-18	Tar River	HU28	15:37	15:40	440633	6361700	440628	6361687	Riffle	10	0.25	0.15	-	-	-	-	-	30	30	40	Trace	-	-	-	Fly larva; thick periphyton growth.
29-May-18	Tar River	HU29	15:40	15:45	440628	6361687	440608	6361659	Run	10-12	0.3	0.2	-	-	-	-	-	10	15	70	5	-	-	-	High water mark approximately 2 m.
30-May-18	Horizon Lake	HZL HU1	13:32	14:02	442038	6361198	442099	6361199	Lake	-	-	-	Low	-	-	-	-	-	-	-	-	-	-	Observed 2 unknown species at rocks	Crew snorkeled out to large rock/boulder.
31-May-18	Tar River	HU30	9:53	9:57	440608	6361659	440567	6361634	Riffle	8-14	0.3	0.2	-	-	-	-	-	20	10	50	20	-	-	-	50% embedded. Thick periphyton growth.
31-May-18	Tar River	HU31	9:57	10:04	440567	6361634	440527	6361626	Run	10-14	1	0.4	-	-	-	-	-	30	50	15	5	-	-	1 FTMN 40 mm	Large woody debris on RDB, gravel bar on LDB. Embeddedness 50%
31-May-18	Tar River	HU32	10:04	10:10	440527	6361626	-	-	Pool	12-14	1.2	0.8	-	-	-	-	-	80	20	-	-	-	-	-	Lots of small and large woody debris on RDB. Iron leachates on RDB
31-May-18	Tar River	HU33	10:10	10:15	-	-	440434	6361631	Riffle	3-14	0.3	0.2	-	-	-	-	-	10	55	30	5	-	-	Fish eggs and 1 fry observed (unknown species)	Small woody debris on LDB. Thick periphyton growth. Iron leachates on LDB pool.
31-May-18	Tar River	HU34	10:15	10:22	440434	6361631	440423	6361641	Pool	10	>1.0	0.7	-	-	-	-	-	50	30	20	Trace	-	-	-	Large and small woody debris. Overhanging bush on LDB
31-May-18	Tar River	HU35	10:22	10:24	440423	6361641	440405	6361636	Riffle	23	0.2	0.1	-	-	-	-	-	20	Trace	40	40	-	-	-	Gravel bar in middle of channel. Small woody debris on LDB. Thick periphyton growth/algal growth
31-May-18	Tar River	HU36	10:24	10:30	440405	6361636	440386	6361640	Run	10-14	0.7	0.3	-	-	-	-	-	50	10	30	10	-	-	-	Large and small woody debris across channel. 50-75 % embedded
31-May-18	Tar River	HU37	10:30	10:34	440386	6361640	440379	6361660	Riffle	8	0.3	0.2	-	-	-	-	-	10	10	40	20	-	-	-	More benthic invertebrates (Trichoptera)
31-May-18	Tar River	HU38	10:34	10:37	440379	6361660	440358	6361654	Run	5	0.8	0.3	-	-	-	-	-	50	30	-	20	-	-	-	Large and small woody debris across channel.

Table A4.1 (Cont'd.)

Date	Watercourse	Habitat Unit	Start Time	End Time	Location: Downstream/ Start UTM E	Location: Downstream/ Start UTM N	Location: Upstream/ End UTM E	Location: Upstream/ End UTM N	Physical Characteristics: Habitat Type	Wetted width (m)	Max depth (m)	Mean depth (m)	Visibility (m)	Flow (m/s; at 50% width, 60% depth)	Organics (%)	Substrate: Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Macrophyte cover (%)	Fish presence/ Spawning indicators	Comments
31-May-18	Tar River	HU39	10:37	10:45	440358	6361654	440335	6361651	Riffle	12-20	0.2	0.1	-	-	-	-	-	10	20	80	-	-	-	Approx. 70 mm unknown species (possible FTMN) in debris	Small woody debris on RDB. 50% embeddedness. Ostrich ferns in riparian zone. Thick algal/periphyton growth
31-May-18	Tar River	HU40	10:45	10:49	440335	6361651	440312	6361648	Run/Pool	8-10	0.7	0.4	-	-	-	-	-	60	10	25	5	-	-	-	Large and small woody debris on RDB (trees, root wads).
31-May-18	Tar River	HU41	10:49	10:52	440312	6361648	440299	6361661	Riffle	14	0.2	0.1	-	-	-	-	-	10	20	60	10	-	-	-	Thick algal growth. Iron leachates on LDB pool.
31-May-18	Tar River	HU42	10:52	10:58	440299	6361661	440283	6361671	Run	4-7	0.4	0.25	-	-	-	-	-	-	10	80	10	-	-	-	Small woody debris on RDB, gravel bar on LDB, Trichoptera/Plecoptera
31-May-18	Tar River	HU43	11:13	11:17	440283	6361671	440296	6361692	Riffle	15	0.25	0.1	-	-	-	-	-	10	30	60	-	-	-	-	Thick periphyton growth. Gravel bar exposed in mid channel
31-May-18	Tar River	HU44	11:17	11:22	440296	6361692	440317	6361700	Run	10-12	1	0.4	-	-	-	-	-	70	-	30	Trace	-	-	-	Large woody debris across channel.
31-May-18	Tar River	HU45	11:22	11:25	440317	6361700	440322	6361716	Pool	-	>1.0	0.6	-	-	-	-	-	90	-	10	-	-	-	-	Small and large woody debris on LDB. 75% embeddedness.
31-May-18	Tar River	HU46	11:25	11:28	440322	6361716	440327	6361739	Riffle	10	0.3	0.15	-	-	-	-	-	Trace	Trace	100	Trace	-	-	-	Small woody debris on RDB, gravel bar on LDB, 75% embeddedness
31-May-18	Tar River	HU47	11:28	11:30	440327	6361739	440334	6361758	Run/Pool	4-10	0.8	0.4	-	-	-	-	-	90	-	10	-	-	-	-	Small woody debris on LDB. 75-100% embeddedness.
31-May-18	Tar River	HU48	11:30	11:31	440334	6361758	440328	6361762	Riffle	6	0.3	0.15	-	-	-	-	-	-	-	80	20	-	-	-	-
31-May-18	Tar River	HU49	11:31	11:33	440328	6361762	440318	6361777	Run/Pool	8-20	1	0.5	-	-	-	-	-	80	-	20	Trace	-	-	-	Small woody debris on LDB.
31-May-18	Tar River	HU50	11:33	11:42	440318	6361777	440225	6361814	Riffle	4-8	0.35	0.2	-	-	-	-	-	10	20	60	10	-	-	-	Small woody debris on RDB. Large gravel bar on LDB (DS) RBD (US). Short run/pool in middle.
31-May-18	Tar River	HU51	11:42	11:45	440225	6361814	440219	6361827	Run/Pool	20-22	0.3	0.2	-	-	-	-	-	40	10	40	10	-	-	-	>75% embeddedness.
31-May-18	Tar River	HU52	11:45	11:47	440219	6361827	-	-	Riffle	16-20	0.3	0.2	-	-	-	-	-	30	20	40	10	-	-	-	25% embeddedness, very little periphyton.
31-May-18	Tar River	HU53	11:47	11:52	-	-	440216	6361860	Run/Pool	12-26	0.7	0.4	-	-	-	-	-	50	10	40	Trace	-	-	-	Large woody debris on LDB. Large log/debris dam in middle. Pool on LDB
31-May-18	Tar River	HU54	11:52	11:54	440216	6361860	440182	6361872	Riffle/Run	6-10	0.3	0.15	-	-	-	-	-	20	-	80	Trace	-	-	-	Small woody debris/undercut LDB, overhanging bushes/branches
31-May-18	Tar River	HU55	11:54	11:57	440182	6361872	440138	6361861	Run	14	0.3	0.2	-	-	-	-	-	10	-	90	Trace	-	-	-	50-75% embeddedness. Small riffle in middle. Uniform/straight channel. Small and large woody debris/overhanging trees.
31-May-18	Tar River	HU56	11:57	11:59	440138	6361861	440127	6361862	Riffle	-	-	-	-	-	-	-	-	-	-	70	30	-	-	-	Channel split into 2 with sand/gravel island in middle. Slope = 5°. Ends at CNRL lease boundary.

Table A4.1 (Cont'd.)

Date	Watercourse	Habitat Unit	Start Time	End Time	Location: Downstream/ Start UTM E	Location: Downstream/ Start UTM N	Location: Upstream/ End UTM E	Location: Upstream/ End UTM N	Habitat Type	Physical Characteristics: Wetted width (m)	Physical Characteristics: Max depth (m)	Physical Characteristics: Mean depth (m)	Physical Characteristics: Visibility (m)	Physical Characteristics: Flow (m/s; at 50% width, 60% depth)	Substrate: Organics (%)	Substrate: Clay (%)	Substrate: Silt (%)	Substrate: Sand (%)	Substrate: Gravel (%)	Substrate: Cobble (%)	Substrate: Boulder (%)	Substrate: Bedrock (%)	Macrophyte cover (%)	Fish presence/ Spawning indicators	Comments
1-Jun-18	Horizon Lake	HZL HU2			441341	6361460	441116	6361388	Lake	-	-	-	0.5	-	-	-	-	-	-	-	-	-	Trace	-	Macrophytes limited, shore = horsetail and grasses. Surveyed trees in lake. Low visibility due to wind and wave action. Substrate sandy loam (deposit).
2-Jun-18	Tar River	HU1	11:17	11:30	441085	6361343	441049	6361332		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 people.
2-Jun-18	Tar River	HU3	11:30	11:42	441056	6361381	441033	6361426	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 people
2-Jun-18	Tar River	HU4	11:43	11.45	441033	6361426	440990	6361430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 people
2-Jun-18	Tar River	HU5	11:46	11:51	440990	6361430	440979	6361436	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Eggs in shallws at bottom of riffle.	One in either channel. Eggs in shallows at bottom of riffle.
2-Jun-18	Tar River	HU6	11:52	11:59	440979	6361436	440940	6361440		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 people
2-Jun-18	Tar River	HU8	12:01	12:18	440929	6361454	440917	6361488	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Observed SLSC (n = 54); SLSC (n = 1) with eggs; 1 TRPR	Algal growth stating (on rocks). Water no longer flowing over middle rock of weir.
2-Jun-18	Tar River	HU9	12:19	12:24	440917	6361488	440897	6361528	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A4.2 Locations of fish sampling sites on Horizon Lake, stratified between the shallow, intermediate, and deep sampling zones, October 2018.

Depth strata	Site ID	UTM Coordinates (NAD 83, Zone 12)			
		Start		End	
		Easting	Northing	Easting	Northing
Shallow	S1	441517	6361417	-	-
	S3	442238	6361127	-	-
	S4	442094	6361178	-	-
	S5	441415	6360935	-	-
	S6	442552	6360600	-	-
	S7	442055	6360474	-	-
	S8	441986	6360388	-	-
	S9	442087	6360423	-	-
	S10	442082	6360542	-	-
	S11	442622	6360661	-	-
	S12	441477	6360815	-	-
	S13	442670	6360790	-	-
	S14	442302	6361062	-	-
	S15	442427	6361050	-	-
	S16	442376	6361025	-	-
	S17	441549	6361111	-	-
	S18	442016	6361174	-	-
	S19	442362	6361167	-	-
	S20	442144	6361196	-	-
	S21	442421	6361124	-	-
	S22	441302	6361373	-	-
	S23	441332	6361439	-	-
	S24	441411	6361394	-	-
	S26	441907	6360373	-	-
	S27	441930	6360453	-	-
	S28	442491	6361037	-	-
	S29	442221	6360406	-	-
	S30	441407	6361442	-	-
	Perimeter	442646	6360676	442632	6360799
	Perimeter	442632	6360799	442434	6360927
	Perimeter	442434	6360927	442422	6361146
	Perimeter	442422	6361146	442202	6361235
	Perimeter	442202	6361235	441922	6361206
	Perimeter	441922	6361206	441689	6361244
	Perimeter	441689	6361244	441548	6361414

Table A4.2 (Cont'd.)

Depth strata	Site ID	UTM Coordinates (NAD 83, Zone 12)			
		Start		End	
		Easting	Northing	Easting	Northing
Intermediate	I1	441488	6361342	-	-
	I3	442241	6360514	-	-
	I5	442090	6360586	-	-
	I6	442598	6360757	-	-
	I7	441470	6360897	-	-
	I10	442183	6361145	-	-
	I13	441496	6361304	-	-
	I14	441509	6361231	-	-
	I16	442326	6360510	-	-
	I17	442110	6360488	-	-
	I18	442511	6360613	-	-
	I20	442576	6360664	-	-
	I21	441469	6360985	-	-
	I22	441631	6361032	-	-
	I23	441614	6360884	-	-
	I24	441378	6361333	-	-
	I25	442209	6361204	-	-
	I26	441546	6361026	-	-
	I29	442380	6360499	-	-
	I30	441348	6361385	-	-
Deep	D3	442388	6360542	-	-
	D4	441950	6360670	-	-
	D5	442007	6360592	-	-
	D8	442540	6360682	-	-
	D10	442047	6360786	-	-
	D18	442231	6360910	-	-
	D23	441861	6361043	-	-
	D24	442104	6360999	-	-
	D26	441607	6361148	-	-
	D33	442300	6360735	-	-
	D41	441926	6361167	-	-
	D43	441762	6361175	-	-

Table A4.3 Fish tissue sampling locations on Calumet Lake and Calumet River, October 2018.

Location	Site ID	UTM Coordinates (NAD 83, Zone 12)			
		Start		End	
		Easting	Northing	Easting	Northing
Calumet Lake	CAL-48	454119	6364535	-	-
	CAL-49	454089	6364547	-	-
	CAL-50	454063	6364525	-	-
	CAL-51	454119	6364248	-	-
	CAL-52	454171	6364250	-	-
	CAL-53	454199	6364208	-	-
	CAL-54	454171	6364292	-	-
	CAL-55	454164	6364364	-	-
	CAL-56	454138	6364420	-	-
	CAL-57	453955	6364581	-	-
	CAL-59	453925	6364662	-	-
	CAL-60	453817	6364601	-	-
	CAL-61	453690	6364451	-	-
	CAL-62	453667	6364290	-	-
	CAL-63	453632	6364164	-	-
	CAL-64	453634	6364045	-	-
	CAL-65	453636	6363924	-	-
	CAL-66	453700	6363728	-	-
	CAL-67	453761	6363564	-	-
	CAL-68	453812	6363462	-	-
	CAL-69	453986	6363460	-	-
	CAL-70	454105	6363461	-	-
	CAL-71	454208	6363537	-	-
	CAL-72	454296	6363738	-	-
	CAL-73	454257	6363874	-	-
	CAL-74	454237	6363958	-	-
	CAL-75	453995	6363915	-	-
	CAL-76	453998	6364135	-	-
	CAL-77	453800	6364397	-	-
	CAL-78	453920	6364449	-	-
	CAL-79	453996	6364475	-	-
	CAL-80	454073	6364430	-	-
	CAL-81	453924	6364326	-	-
	CAL-82	454031	6364291	-	-
	CAL-83	454095	6364176	-	-
	CAL-84	454125	6364071	-	-
	CAL-85	454206	6364076	-	-

Table A4.3 (Cont'd.)

Location	Site ID	UTM Coordinates (NAD 83, Zone 12)			
		Start		End	
		Easting	Northing	Easting	Northing
	CAL-86	454131	6363956	-	-
	CAL-87	454255	6363915	-	-
	CAL-88	454120	6363810	-	-
	CAL-89	454230	6363705	-	-
	CAL-90	454313	6363641	-	-
	CAL-91	454295	6363492	-	-
	CAL-92	454297	6363471	-	-
	CAL-93	454114	6363670	-	-
	CAL-94	454019	6363547	-	-
	CAL-95	454004	6363754	-	-
	CAL-96	453917	6363601	-	-
	CAL-97	453918	6363447	-	-
	CAL-98	453703	6363656	-	-
	CAL-99	453833	6363830	-	-
	CAL-100	453836	6364025	-	-
	CAL-101	453983	6364063	-	-
	CAL-102	453733	6363937	-	-
	CAL-103	453627	6364004	-	-
	CAL-104	453743	6364099	-	-
	CAL-105	453881	6364226	-	-
	CAL-106	453784	6364255	-	-
	CAL-107	453640	6364236	-	-
	CAL-108	453704	6364399	-	-
	CAL-109	453756	6364525	-	-
	CAL-110	453879	6364527	-	-
Calumet River	EF-1	460757	6363185	460622	6363154
	EF-2	460622	6363154	460442	6363069
	EF-3	460442	6363069	460198	6363041

Table A4.4 Summary of gill netting effort for the fall fish program at Horizon Lake, October 2018.

Sampling Strata	Site	Number of Panels	Duration (d)	Fishing Effort (panel-d)
Shallow	S15	8	0.045	0.361
	S22	8	0.060	0.478
	S10	8	0.080	0.639
	S18	8	0.077	0.617
	S29	8	0.073	0.583
	S26	1	0.049	0.049
	S4	1	0.079	0.079
	S9	1	0.082	0.082
Intermediate	I30	8	0.072	0.572
	I5	8	0.076	0.606
	I13	8	0.071	0.567
	I24	8	0.070	0.561
	I23	8	0.069	0.556
	I22	8	0.072	0.578
	I6	8	0.107	0.856
	I20	8	0.080	0.639
	I6	8	0.069	0.556
	I17	8	0.079	0.633
	I3	8	0.080	0.639
	I14	8	0.081	0.650
	I10	8	0.069	0.550
	I29	8	0.079	0.633
Deep	D10	8	0.079	0.633
	D5	8	0.078	0.622
	D3	8	0.068	0.544
	D26	8	0.081	0.650
	D41	8	0.078	0.622

d: days

Table A4.5 Summary of minnow trapping effort for the fall fish program at Horizon Lake, October 2018.

Sampling Strata	Site	Number of traps	Set Duration (d)	Trap Effort (trap-d)
Shallow	S5	4	0.826	3.31
	S1	5	0.837	4.18
	S8	4	0.822	3.29
	S22	5	0.837	4.18
	S23	5	0.828	4.14
	S7	5	0.899	4.50
	S9	5	0.905	4.52
	S4	5	0.765	3.83
	S30	5	0.826	4.13
	S12	5	0.881	4.41
	S6	5	0.884	4.42
	S16	5	0.890	4.45
	S21	5	0.839	4.19
	S17	5	0.704	3.52
	S3	4	0.805	3.22
	S14	5	0.828	4.14
	S16	5	0.835	4.17
	S13	5	0.875	4.38
	S6	5	0.844	4.22
	S11	5	0.851	4.25
	S28	5	0.892	4.46
	S18	5	0.890	4.45
	S29	5	0.869	4.35
	S19	5	0.999	5.00
	S27	5	1.017	5.09
	S24	5	0.983	4.92
	S15	5	1.025	5.13
	S21	5	1.030	5.15
	S22	5	1.006	5.03
Intermediate	I18	5	0.876	4.38
	I20	5	0.864	4.32
	I25	5	0.875	4.38
	I16	5	0.757	3.78
	I5	5	0.899	4.50
	I26	5	0.703	3.51
	I1	5	0.796	3.98
	I7	4	0.797	3.19
	I21	5	0.804	4.02

Table A4.5 (Cont'd.)

Sampling Strata	Site	Number of traps	Set Duration (d)	Trap Effort (trap-d)
Deep	D8	5	0.823	4.11
	D24	5	0.864	4.32
	D4	5	0.877	4.39
	D33	5	0.000	0.00
	D23	5	0.799	3.99
	D18	5	0.859	4.30
	D41	5	0.821	4.10
	D43	5	0.812	4.06

Table A4.6 Summary of fyke net effort at Horizon Lake, October 2018.

Sampling Strata	Site	Set Duration (d)
Shallow	S13	0.988
	S20	0.979
	S19	0.927
	S9	0.965
	S20	0.997
	S11	0.917
	S8	0.970
	S27	0.960

d: days

Table A4.7 Condition index for fish ageing structure analysis, North/South Consultants Inc., 2018.

Condition	Qualitative characteristics (pattern clarity)	Quantitative characteristics (repeatability)
Very Good (VG)	annuli are clear with no interpretation problems	Reader always gets the same age
Good (G)	annuli are clear with a few easy interpretation problems	Reader would get the same age most of the time for fish <10 years, within one year for fish 11-20 years
Fair (F)	annuli are fairly clear with some areas presenting easy and moderate interpretation problems	Reader would be within 1 year most of the time for fish<10 years and 2-3 years for fish >10 years
Poor (P)	annuli are fairly unclear presenting a number of difficult interpretation problems	Reader would be within 2-3 years most of the time for fish <10 years and 4-5 years for fish >10 years
Very Poor (VP)	annuli are very unclear presenting significant interpretation problems	Reader has little confidence in repeatability of age within 4-5 years

Table A4.8 Fish ageing structure analysis, North/South Consultants Inc., spring 2018.

Location	Date	Structures	Species	Fish ID	Age	Con. Index	QA/QC
					ML		KA
TAR River Upper	22/May/18	FR	WHSC	23	3	G	
TAR River Upper	22/May/18	FR	WHSC	24	3	G	
TAR River Upper	22/May/18	FR	WHSC	25	9	G	
TAR River Upper	22/May/18	FR	WHSC	26	10	F	
TAR River Upper	23/May/18	FR	WHSC	206	6	G	6
TAR River Upper	23/May/18	FR	LNSC	207	7	G	7
TAR River Upper	23/May/18	FR	LNSC	208	8	F	7
TAR River Upper	23/May/18	FR	LNSC	209	6	G	6
TAR River Upper	23/May/18	FR	WHSC	211	6	G	
TAR River Upper	23/May/18	FR	LNSC	212	6	G	
TAR River Upper	23/May/18	FR	LNSC	213	6	G	
TAR River Upper	23/May/18	FR	WHSC	214	6	G	
TAR River Upper	23/May/18	FR	WHSC	215	6	G	
TAR River Upper	23/May/18	FR	LNSC	216	7	G	
TAR River Upper	23/May/18	FR	WHSC	217	7	G	
TAR River Upper	23/May/18	FR	WHSC	237	7	G	
TAR River Upper	23/May/18	FR	WHSC	239	7	F	
TAR River Upper	24/May/18	FR	LNSC	286	7	F	
TAR River Upper	24/May/18	FR	LNSC	287	6	G	
TAR River Upper	24/May/18	FR	LNSC	292	6	G	
TAR River Upper	24/May/18	FR	LNSC	293	7	G	
TAR River Upper	24/May/18	FR	LNSC	294	7	G	
TAR River Upper	24/May/18	FR	WHSC	303	5	G	
TAR River Upper	24/May/18	FR	WHSC	304	6	G	
TAR River Upper	24/May/18	FR	WHSC	305	10	G	
TAR River Upper	24/May/18	FR	WHSC	315	5	G	
TAR River Upper	25/May/18	FR	LNSC	337	6	G	
TAR River Upper	24/May/18	FR	WHSC	341	5	G	

FR: Fin Ray.

Table A4.9 Fish ageing structure analysis, North/South Consultants Inc., fall 2018.

Location	Date	Structures	Species	Fish ID	Age	Con. Index	QA/QC	Comments
					KA		ML	
Calumet River	2-Oct-18	FR	WHSC	142	1	G	1	
Calumet River	2-Oct-18	FR	WHSC	143	1	G	1	
Calumet River	2-Oct-18	FR	WHSC	146	2	P		
Calumet River	2-Oct-18	FR	WHSC	147	2	G		
Calumet River	2-Oct-18	FR	WHSC	148	2	F		
Calumet River	2-Oct-18	FR	LKCH	138	2	F		
Calumet River	2-Oct-18	FR	LKCH	139	2	F		
Calumet River	2-Oct-18	FR	LKCH	140	2	F		
Calumet River	2-Oct-18	FR	LKCH	141	1	F		
Calumet River	2-Oct-18	FR	LKCH	154	1	F		
I5	4-Oct-18	SC	ARGR	29	3	F		
I5	4-Oct-18	SC	ARGR	31	3	F		
I23	5-Oct-18	SC	ARGR	168	3	F		
D3	5-Oct-18	SC	ARGR	188	3	F		
I6	5-Oct-18	SC	ARGR	189	3	F		
I6	5-Oct-18	SC	ARGR	190	3	F		
I6	6-Oct-18	SC	ARGR	348	3	F		
I6	6-Oct-18	SC	ARGR	349	3	F		
D41	8-Oct-18	SC	ARGR	435	2	F		
I29	8-Oct-18	SC	ARGR	459	2	F		
S8	4-Oct-18	FR	FTMN	22	1	F	1	
S8	4-Oct-18	FR	FTMN	23	2	F	2	
S8	4-Oct-18	FR	FTMN	24	1	F	1	
S8	4-Oct-18	FR	FTMN	25	1	F	1	
S8	4-Oct-18	FR	FTMN	26	1	F		
S5	4-Oct-18	FR	FTMN	41	2	F		
S5	4-Oct-18	FR	FTMN	45	1	F		
S5	4-Oct-18	FR	FTMN	47	1	F		
S5	4-Oct-18	FR	FTMN	48	1	F		
S5	4-Oct-18	FR	FTMN	49	2	F		
S5	4-Oct-18	FR	FTMN	50	1	F		
S5	4-Oct-18	FR	FTMN	51	1	F		
S5	4-Oct-18	FR	FTMN	52	1	F		
S5	4-Oct-18	FR	FTMN	53	2	F		
S5	4-Oct-18	FR	FTMN	55	2	F		
S5	4-Oct-18	FR	FTMN	56	2	F		
S5	4-Oct-18	FR	FTMN	59	1	F		
S5	4-Oct-18	FR	FTMN	62	2	F		
S5	4-Oct-18	FR	FTMN	63	2	F		
S5	4-Oct-18	FR	FTMN	64	2	F		
S5	4-Oct-18	FR	FTMN	65	2	F		
S5	4-Oct-18	FR	FTMN	66	2	F		

Table A4.9 (Cont'd.)

Location	Date	Structures	Species	Fish ID	Age	Con. Index	QA/QC	Comments
					KA		ML	
S5	4-Oct-18	FR	FTMN	68	1	F		
S5	4-Oct-18	FR	FTMN	69	1	F		
S5	4-Oct-18	FR	FTMN	70	2	F		
S5	4-Oct-18	FR	FTMN	72	1	F		
S5	4-Oct-18	FR	FTMN	79	2	F		
S5	4-Oct-18	FR	FTMN	80	1	F		
S5	4-Oct-18	FR	FTMN	83	2	F		
S5	4-Oct-18	FR	FTMN	88	2	F		
S23	5-Oct-18	FR	FTMN	91	2	F		
S23	5-Oct-18	FR	FTMN	93	0	F		
S23	5-Oct-18	FR	FTMN	95	0	F		
S7	5-Oct-18	FR	FTMN	97	0	F		
S7	5-Oct-18	FR	FTMN	100	0	F		
S7	5-Oct-18	FR	FTMN	102	0	F		
S7	5-Oct-18	FR	FTMN	108	0	F		
S7	5-Oct-18	FR	FTMN	116	0	F		
S7	5-Oct-18	FR	FTMN	120	0	F		
S9	5-Oct-18	FR	FTMN	129	2	F		
S9	5-Oct-18	FR	FTMN	140	2	F		
S13	5-Oct-18	FR	FTMN	179	ua	VVP		
I18	6-Oct-18	FR	FTMN	220	2	P		
I18	6-Oct-18	FR	FTMN	224	2	F		
I18	6-Oct-18	FR	FTMN	231	2	F		
I20	6-Oct-18	FR	FTMN	304	0	F		
I20	6-Oct-18	FR	FTMN	317	2	F		
I20	6-Oct-18	FR	FTMN	325	0	F		
S6	7-Oct-18	FR	FTMN	372	1	P		
S6	7-Oct-18	FR	FTMN	374	1	P		
S6	7-Oct-18	FR	FTMN	379	1	F		
D23	8-Oct-18	FR	FTMN	443	2	F		
D23	8-Oct-18	FR	FTMN	445	2	F		
D43	9-Oct-18	FR	FTMN	520	2	F		
I13	4-Oct-18	FR	LKCH	40	1	G	1	
S4	5-Oct-18	FR	LKCH	154	1	G	1	
D5	5-Oct-18	FR	LKCH	186	4	G	4	
D8	6-Oct-18	FR	LKCH	204	1	G	1	
D8	6-Oct-18	FR	LKCH	210	1	F		
I18	6-Oct-18	FR	LKCH	230	1	G		
I18	6-Oct-18	FR	LKCH	275	1	F		
I18	6-Oct-18	FR	LKCH	296	2	G		
I18	6-Oct-18	FR	LKCH	298	4	G		
I20	6-Oct-18	FR	LKCH	308	1	F		

Table A4.9 (Cont'd.)

Location	Date	Structures	Species	Fish ID	Age	Con. Index	QA/QC	Comments
						KA	ML	
I20	6-Oct-18	FR	LKCH	333	0	F		
I16	6-Oct-18	FR	LKCH	341	1	G		
I16	6-Oct-18	FR	LKCH	343	0	F		
I16	6-Oct-18	FR	LKCH	344	2	F		
S6	7-Oct-18	FR	LKCH	375	0	P		
S6	7-Oct-18	FR	LKCH	380	0	F		
S3	8-Oct-18	FR	LKCH	437	2	G		
I29	8-Oct-18	FR	LKCH	461	1	F		
S14	9-Oct-18	FR	LKCH	471	3	G		
D41	9-Oct-18	FR	LKCH	480	1	F		
D43	9-Oct-18	FR	LKCH	481	1	G		
D43	9-Oct-18		LKCH	490	ns			no FR in env.
D43	9-Oct-18	FR	LKCH	492	2	F		Fish ID should be 495.
D43	9-Oct-18	FR	LKCH	500	2	F		
D43	9-Oct-18	FR	LKCH	506	4	F		
D43	9-Oct-18	FR	LKCH	508	4	G		
D43	9-Oct-18	FR	LKCH	510	3	G		
D43	9-Oct-18	FR	LKCH	513	3	G		
D43	9-Oct-18	FR	LKCH	515	2	F		
D43	9-Oct-18	FR	LKCH	516	1	F		
D43	9-Oct-18	FR	LKCH	517	1	F		
D43	9-Oct-18	FR	LKCH	518	2	F		
D10	5-Oct-18	FR	LNSC	171	2	G		
I20	6-Oct-18	FR	LNSC	346	2	G		
S1	4-Oct-18	FR	WHSC	16	1	F		
S1	4-Oct-18	FR	WHSC	17	2	P		
I5	4-Oct-18	FR	WHSC	27	5	F		
I5	4-Oct-18	OT	WHSC	27	7	P		
S15	4-Oct-18	FR	WHSC	28	4	G		
S15	4-Oct-18	FR	WHSC	32	5	F		
S15	4-Oct-18	FR	WHSC	33	5	F		
S15	4-Oct-18	OT	WHSC	33	7	P		
I5	4-Oct-18	FR	WHSC	36	2	G	2	
I5	4-Oct-18	FR	WHSC	37	5	G	5	
I13	4-Oct-18	FR	WHSC	38	6	G	6	
I13	4-Oct-18	FR	WHSC	39	4	G	4	
I24	4-Oct-18	FR	WHSC	89	5	F		
I23	5-Oct-18	FR	WHSC	169	5	F		
I23	5-Oct-18	FR	WHSC	170	2	F		
I23	5-Oct-18	FR	WHSC	172	2	F		
I23	5-Oct-18	FR	WHSC	173	5	F		

Table A4.9 (Cont'd.)

Location	Date	Structures	Species	Fish ID	Age	Con. Index	QA/QC	Comments
						KA	ML	
I23	5-Oct-18	FR	WHSC	174	1	P		
I23	5-Oct-18	FR	WHSC	175	8	G		
I23	5-Oct-18	FR	WHSC	176	4	G	5	
D5	5-Oct-18	FR	WHSC	187	4	G	4	
I6	5-Oct-18	FR	WHSC	191	1	F	1	
I6	5-Oct-18	FR	WHSC	192	3	F	3	
I6	5-Oct-18	FR	WHSC	193	5	F		
I6	5-Oct-18	FR	WHSC	194	5	F		
I6	5-Oct-18	FR	WHSC	195	8	F		
I6	5-Oct-18	FR	WHSC	196	2	F		
I6	5-Oct-18	FR	WHSC	197	4	F		
I6	5-Oct-18	FR	WHSC	198	2	F		
I6	5-Oct-18	FR	WHSC	199	2	F		
I6	5-Oct-18	FR	WHSC	200	9	F		
I20	6-Oct-18	FR	WHSC	347	2	G		
I6	6-Oct-18	FR	WHSC	351	6	G		
S18	8-Oct-18	FR	WHSC	436	6	F		
D23	8-Oct-18	FR	WHSC	444	2	F		
D23	8-Oct-18	FR	WHSC	446	2	F		
S18	8-Oct-18	FR	WHSC	462	6	F		
D41	9-Oct-18	FR	WHSC	472	1	F		
D41	9-Oct-18	FR	WHSC	478	1	F		
D41	9-Oct-18	FR	WHSC	479	1	F		
D43	9-Oct-18	FR	WHSC	482	1	F		
D43	9-Oct-18	FR	WHSC	483	1	F		
D43	9-Oct-18	FR	WHSC	501	1	F		
D43	9-Oct-18	FR	WHSC	514	1	F		
S11	10-Oct-18	FR	WHSC	537	2	F		

Table A4.10 Fish captured during the spring fish program at Tar River, 2018.

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
14-May-18	17:18	440894	6361517	15-May-18	9:03	Minnow Trap	1 trap	MT03	3	LKCH	70	3.7	1	-	-	-	-	-	N	-	-	-	-	Photos
14-May-18	17:20	440900	6361537	15-May-18	9:18	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
14-May-18	17:00	440893	6361505	15-May-18	9:20	Minnow Trap	1 trap	MT02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
14-May-18	17:05	440909	6361483	15-May-18	9:23	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
14-May-18	17:25	440894	6361555	15-May-18	9:30	Fyke Net	1 net	FYKE02	4	FTMN	66	3.7	1	-	-	-	-	-	N	-	-	-	-	Mort.
14-May-18	17:15	440903	6361497	15-May-18	9:48	Fyke Net	1 net	FYKE01	5	LKCH	104	11.4	1	-	-	-	-	-	N	-	-	-	-	
15-May-18	9:25	440909	6361483	15-May-18	16:20	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
15-May-18	9:26	440893	6361505	15-May-18	16:22	Minnow Trap	1 trap	MT02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
15-May-18	9:17	440894	6361517	15-May-18	16:25	Minnow Trap	1 trap	MT03	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
15-May-18	9:27	440900	6361537	15-May-18	16:26	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
15-May-18	9:41	440894	6361555	15-May-18	16:27	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
15-May-18	9:50	440903	6361497	15-May-18	16:23	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
15-May-18	16:21	440909	6361483	16-May-18	8:32	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
15-May-18	16:23	440893	6361505	16-May-18	8:36	Minnow Trap	1 trap	MT02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
15-May-18	16:26	440894	6361517	16-May-18	8:38	Minnow Trap	1 trap	MT03	6	SLSC	62	2	1	-	-	-	-	-	N	-	-	-	-	
15-May-18	16:28	440900	6361537	16-May-18	8:44	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
15-May-18	16:30	440894	6361555	16-May-18	9:05	Fyke Net	1 net	FYKE02	8	FTMN	65	3	1	-	-	-	-	-	N	-	-	-	-	Wood frog.
16-May-18	8:33	440909	6361483	16-May-18	16:11	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	
16-May-18	8:35	440893	6361505	16-May-18	16:12	Minnow Trap	1 trap	MT02	9	SLSC	66	2	1	-	-	-	-	-	N	-	-	-	-	
16-May-18	8:59	440903	6361497	16-May-18	16:14	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
16-May-18	8:40	440894	6361517	16-May-18	16:15	Minnow Trap	1 trap	MT03	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
16-May-18	8:45	440900	6361537	16-May-18	16:16	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
16-May-18	9:10	440894	6361555	16-May-18	16:21	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	Lots of debris, no fish.
16-May-18	16:12	440909	6361483	17-May-18	8:28	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
16-May-18	16:13	440893	6361505	17-May-18	8:30	Minnow Trap	1 trap	MT02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
16-May-18	16:17	440894	6361517	17-May-18	8:34	Minnow Trap	1 trap	MT03	10	FTMN	65	2.5	1	-	-	-	-	-	N	-	-	-	-	
16-May-18	16:17	440894	6361517	17-May-18	8:34	Minnow Trap	1 trap	MT03	11	LKCH	54	1.5	1	-	-	-	-	-	N	-	-	-	-	
16-May-18	16:15	440903	6361497	17-May-18	8:34	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
16-May-18	16:23	440894	6361555	17-May-18	8:45	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
16-May-18	16:20	440900	6361537	17-May-18	8:39	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
17-May-18	8:29	440909	6361483	17-May-18	15:06	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
17-May-18	8:31	440893	6361505	17-May-18	15:06	Minnow Trap	1 trap	MT02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
17-May-18	8:36	440894	6361517	17-May-18	15:07	Minnow Trap	1 trap	MT03	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
17-May-18	8:40	440900	6361537	17-May-18	15:08	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
17-May-18	8:35	440903	6361497	17-May-18	15:12	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
17-May-18	8:50	440894	6361555	17-May-18	15:14	Fyke Net	1 net	FYKE02	Tally	LKCH	-	-	2	-	-	-	-	-	N	-	-	-	-	Released for safety.
22-May-18	11:55	440900	6361537	22-May-18	15:56	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
22-May-18	12:00	440894	6361555	22-May-18	15:55	Fyke Net	1 net	FYKE02	12	LKCH	94	9.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:10	440894	6361517	22-May-18	15:58	Minnow Trap	1 trap	MT03	13	LKCH	90	7.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:10	440894	6361517	22-May-18	15:58	Minnow Trap	1 trap	MT03	14	FTMN	56	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:07	440893	6361505	22-May-18	16:05	Minnow Trap	1 trap	MT02	15	FTMN	70	3.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	16	LKCH	70	3.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	17	FTMN	58	2.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	18	FTMN	71	4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	19	FTMN	52	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	20	FTMN	65	4.1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:20	440903	6361497	22-May-18	16:25	Fyke Net	1 net	FYKE01	21	FTMN	74	4.1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440903	6361497	22-May-18	16:25	Fyke Net	1 net	FYKE01	22	LKCH	73	4.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	27	FTMN	53	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	28	FTMN	60	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	29	FTMN	65	2.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	30	BRST	59	1.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	31	FTMN	65	2.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	32	FTMN	69	3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	33	LKCH	70	4.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	34	BRST	64	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	35	FTMN	64	2.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	36	FTMN	59	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	37	BRST	60	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	38	FTMN	56	2.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	39	FTMN	55	1.9	1	-	-	-	-	-	N	-	-	-	-	Bump on peduncle (possible fish lice)
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	40	FTMN	52	1.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	41	FTMN	69	3.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	42	FTMN	58	1.9	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	43	BRST	61	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	45	FTMN	65	2.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	46	FTMN	63	2.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	47	BRST	59	1.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	48	BRST	51	1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	49	FTMN	56	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	50	BRST	55	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	51	FTMN	58	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	52	FTMN	60	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	53	BRST	53	1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	54	FTMN	70	3.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	55	FTMN	55	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	56	FTMN	63	2.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	57	FTMN	66	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	58	BRST	56	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	59	BRST	57	1.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	60	FTMN	60	2.1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	61	FTMN	67	3.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	62	BRST	58	1.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	63	FTMN	69	2.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	64	FTMN	56	1.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	65	LNSC	118	15.8	1	-	-	-	-	-	N	-	-	-	-	Juvenile - pics taken
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	66	FTMN	68	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	67	FTMN	56	0.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	68	FTMN	67	2.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	69	FTMN	61	2.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	70	FTMN	61	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	71	FTMN	66	2.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	72	FTMN	56	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	73	FTMN	66	3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	74	FTMN	58	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	75	FTMN	67	2.4	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	76	FTMN	68	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	77	FTMN	66	3.1	1	-	-	-	-	-	N	-	-	-	-	Eroded caudal.
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	78	FTMN	66	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	79	FTMN	66	3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	80	FTMN	64	2.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	81	FTMN	63	2.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	82	FTMN	55	1.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	83	FTMN	55	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	84	FTMN	67	3.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	85	FTMN	62	2.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	86	FTMN	64	2.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	87	FTMN	70	3.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	88	FTMN	55	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	89	FTMN	68	3.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	90	LKCH	71	4	1	-	-	-	-	-	N	-	-	-	-	Fish lice.
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	91	FTMN	72	3.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	92	FTMN	61	2.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	93	BRST	51	1.1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	94	FTMN	64	2.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	95	FTMN	63	2.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	96	FTMN	55	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	97	LKCH	66	2.9	1	-	-	-	-	-	N	-	-	-	-	Fish lice.
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	98	FTMN	56	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	99	FTMN	74	4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	100	FTMN	58	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	101	FTMN	63	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	102	SLSC	57	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	103	FTMN	64	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	104	FTMN	62	2.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	105	FTMN	58	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	106	FTMN	66	2.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	107	FTMN	57	1.8	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	108	FTMN	57	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	109	FTMN	52	1.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	110	FTMN	55	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	111	FTMN	64	2.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	112	FTMN	52	1.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	113	BRST	55	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	113	FTMN	54	2.2	1	-	-	-	-	-	N	-	-	-	-	Two number 113s
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	114	FTMN	67	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	115	FTMN	57	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	116	FTMN	58	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	117	FTMN	58	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	118	FTMN	58	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	119	FTMN	58	1.8	1	-	-	-	-	-	N	-	-	-	-	Hemorrhaging.
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	120	FTMN	55	1.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	121	FTMN	61	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	122	FTMN	54	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	123	FTMN	54	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	124	FTMN	60	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	125	FTMN	53	1.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	126	FTMN	54	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	127	BRST	57	1.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	128	FTMN	59	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	129	FTMN	56	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:59	440894	6361517	23-May-18	9:15	Minnow Trap	1 trap	MT03	130	FTMN	55	1.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	131	LKCH	100	9.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	132	FTMN	66	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	133	FTMN	65	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	134	LKCH	59	1.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	135	FTMN	58	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	136	FTMN	65	2.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	137	FTMN	66	2.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	138	FTMN	70	3.5	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	139	FTMN	60	2.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	140	FTMN	64	2.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	141	FTMN	64	2.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	142	FTMN	55	1.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	143	FTMN	61	2.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	144	FTMN	61	2.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	145	LKCH	74	4.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	146	FTMN	67	3.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	147	LKCH	80	5.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	148	FTMN	66	3.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	149	FTMN	65	2.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	150	FTMN	70	3.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	151	FTMN	56	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	152	FTMN	72	4.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	153	FTMN	63	2.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	154	FTMN	67	2.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	155	LKCH	88	7.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	156	FTMN	72	3.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	157	FTMN	71	4.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	158	FTMN	58	1.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	159	FTMN	70	2.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	160	FTMN	66	2.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	161	FTMN	68	3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	162	FTMN	58	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	163	FTMN	65	2.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	40	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	164	LKCH	93	8.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	10	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	165	LKCH	96	11	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	25	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	10	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	166	LKCH	72	2.7	1	-	-	-	-	-	N	-	-	-	-	

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Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	167	LKCH	104	10.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	10	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	168	LKCH	88	6.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	169	LKCH	85	5.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	170	LKCH	80	4.8	1	-	-	-	-	-	N	-	-	-	-	Missing top half of caudal fin.
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	5	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	25	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	171	LKCH	86	6.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	172	LKCH	55	1.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	173	BRST	66	2.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	174	LKCH	91	9.1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	175	BRST	54	1.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	176	LKCH	52	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	10	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	177	LKCH	100	9.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	178	LKCH	71	4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	179	LKCH	77	4.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	10	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	180	LKCH	88	7.9	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	181	LKCH	78	5.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	182	LKCH	90	7.1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	183	LKCH	85	6.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	184	LKCH	88	6.6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	185	LKCH	85	6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	186	LKCH	92	7.8	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	187	LKCH	82	5.7	1	-	-	-	-	-	N	-	-	-	-	Male - milting.
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	188	LKCH	77	5.5	1	-	-	-	-	-	N	-	-	-	-	Male - milting.
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	189	LKCH	85	6.5	1	-	-	-	-	-	N	-	-	-	-	Male - milting.
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	190	LKCH	86	6.8	1	-	-	-	-	-	N	-	-	-	-	Male - milting.

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	5	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	191	LKCH	86	6	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	192	LKCH	84	6.9	1	-	-	-	-	-	N	-	-	-	-	Milt - male.
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	193	LKCH	86	6.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	194	LKCH	88	7.1	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:57	440900	6361537	23-May-18	9:45	Minnow Trap	1 trap	MT04	Tally	FTMN	-	-	2	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:06	440893	6361505	23-May-18	10:30	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	100	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:06	440893	6361505	23-May-18	10:30	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	30	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:06	440893	6361505	23-May-18	10:30	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:06	440893	6361505	23-May-18	10:30	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:06	440893	6361505	23-May-18	10:30	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:06	440893	6361505	23-May-18	10:30	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	16	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:06	440893	6361505	23-May-18	10:30	Minnow Trap	1 trap	MT02	195	BRST	54	1.3	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	196	LKCH	88	6.7	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	197	LKCH	80	5.1	1	-	-	-	-	-	N	-	-	-	-	Milt - male
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	198	LKCH	77	5.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	10	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	199	SLSC	70	2.5	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	13	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	200	BRST	67	2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	201	SLSC	52	1.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	202	SLSC	53	1.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	203	LKCH	52	1.2	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	204	BRST	60	1.4	1	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	205	WHSC	70	3.3	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	16:07	440909	6361483	23-May-18	10:48	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	3	-	-	-	-	-	N	-	-	-	-	
22-May-18	15:58	440894	6361555	23-May-18	11:15	Fyke Net	1 net	FYKE02	Tally	FTMN	-	-	2	-	-	-	-	-	N	-	-	-	-	
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	Tally	FTMN	-	-	3	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:46	440900	6361537	23-May-18	15:21	Minnow Trap	1 trap	MT04			-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
23-May-18	11:21	440894	6361555	23-May-18	15:20	Fyke Net	1 net	FYKE02			-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
23-May-18	11:43	440894	6361517	23-May-18	15:23	Minnow Trap	1 trap	MT03	218	LKCH	94	6.8	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:43	440894	6361517	23-May-18	15:23	Minnow Trap	1 trap	MT03	219	LKCH	88	8.2	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:43	440894	6361517	23-May-18	15:23	Minnow Trap	1 trap	MT03	Tally	FTMN	-	-	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	70	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	10	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	20	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	220	LKCH	57	1.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	221	BRST	63	1.8	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	223	BRST	58	1.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	224	BRST	63	1.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	225	LKCH	68	2.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	226	SLSC	60	1.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	227	BRST	64	1.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	228	SLSC	54	1.3	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	229	BRST	61	1.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	230	SLSC	62	1.8	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	231	BRST	59	1.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	232	LKCH	55	1.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	233	SLSC	55	1.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	234	SLSC	61	1.6	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	235	LKCH	53	1.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	236	SLSC	56	1.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:40	440909	6361483	23-May-18	15:25	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	3	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	Tally	FTMN	-	-	21	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	241	LKCH	95	8.6	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	242	LKCH	83	4.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	243	LKCH	63	1.4	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	245	LKCH	97	11.2	1	-	-	-	-	-	N	-	-	-	-	Hemoragging on body
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	246	LKCH	120	10.6	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	247	LKCH	86	5.9	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	248	LKCH	85	6.2	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	249	LKCH	78	5.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	250	LKCH	86	6.3	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	251	LKCH	78	4.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	252	LKCH	66	2.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	253	LKCH	64	1.9	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	11:41	440893	6361505	23-May-18	15:26	Minnow Trap	1 trap	MT02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	254	LKCH	93	7.9	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	Tally	FTMN	-	-	370	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	255	LKCH	92	7.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	256	LKCH	104	10.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	257	LKCH	86	6.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	258	LKCH	72	4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	259	LKCH	84	6.6	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	260	LKCH	82	6.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	261	LKCH	67	3.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	262	LKCH	84	6.1	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	263	LKCH	103	10.6	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	264	LKCH	75	4.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	265	LKCH	80	6	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	266	LKCH	100	10.2	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10 35	Minnow Trap	1 trap	MT03	267	LKCH	92	7.9	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	268	LKCH	77	5.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	269	LKCH	79	5.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:22	440900	6361537	24-May-18	10.55	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	273	LKCH	80	6.2	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	327	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	274	LKCH	102	10.8	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	275	LKCH	76	4.7	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	276	LKCH	56	1.6	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	277	BRST	54	1	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	278	BRST	62	2	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:28	440893	6361505	24-May-18	11:00	Minnow Trap	1 trap	MT02	279	BRST	61	1.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	255	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Minnow Trap	1 trap	MT01	280	LKCH	51	1.3	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Minnow Trap	1 trap	MT01	281	BRST	59	1.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Minnow Trap	1 trap	MT01	282	LKCH	53	1.3	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Minnow Trap	1 trap	MT01	283	BRST	63	1.7	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Minnow Trap	1 trap	MT01	284	SLSC	59	1.4	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Fyke Net	1 net	FYKE01	Tally	FTMN	-	-	4	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:50	440903	6361497	24-May-18	11:50	Fyke Net	1 net	FYKE01	344	LKCH	81	6.5	1	-	-	-	-	-	N	-	-	-	-	
23-May-18	15:20	440894	6361555	24-May-18	11:40	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
24-May-18	11:42	440894	6361555	24-May-18	15:00	Fyke Net	1 net	FYKE02	Tally	FTMN	-	-	2	-	-	-	-	-	N	-	-	-	-	
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	Tally	FTMN	-	-	4	-	-	-	-	-	N	-	-	-	-	
29-May-18	14:10	440909	6361483	30-May-18	9:30	Minnow Trap	1 trap	MT01	354	LKCH	75	3.9	1	-	-	-	-	-	N	-	-	-	-	
29-May-18	14:10	440909	6361483	30-May-18	9:30	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	5	-	-	-	-	-	N	-	-	-	-	
29-May-18	14:40	440894	6361555	30-May-18	9:55	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
30-May-18	9:31	440909	6361483	30-May-18	14:46	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
30-May-18	9:41	440903	6361497	30-May-18	14:45	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
30-May-18	9:56	440894	6361555	30-May-18	14.50	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
30-May-18	14:47	440909	6361483	31-May-18	8:50	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	1	-	-	-	-	-	N	-	-	-	-	
30-May-18	14:45	440903	6361497	31-May-18	8:52	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
30-May-18	14:52	440894	6361555	31-May-18	8:55	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
31-May-18	8:52	440909	6361483	31-May-18	16:00	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
31-May-18	8:54	440903	6361497	31-May-18	16:00	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish, otter holes in net.
31-May-18	8:56	440894	6361555	31-May-18	16:02	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish, otter holes in net.
31-May-18	16:01	440909	6361483	01-Jun-18	8:46	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	3	-	-	-	-	-	N	-	-	-	-	
31-May-18	16:01	440903	6361497	01-Jun-18	8:45	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
31-May-18	16:03	440894	6361555	01-Jun-18	8:50	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
01-Jun-18	8:47	440909	6361483	01-Jun-18	14:25	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
01-Jun-18	8:46	440903	6361497	01-Jun-18	14:26	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
01-Jun-18	8:51	440894	6361555	01-Jun-18	14:28	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
01-Jun-18	14:30	440909	6361483	02-Jun-18	8:30	Minnow Trap	1 trap	MT01	Tally	FTMN	-	-	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:32	440893	6361505	02-Jun-18	8:50	Minnow Trap	1 trap	MT02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
01-Jun-18	14:34	440894	6361517	02-Jun-18	9:10	Minnow Trap	1 trap	MT03	Tally	FTMN	-	-	3	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:36	440900	6361537	02-Jun-18	9:12	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	356	LKCH	102	12.3	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	357	LKCH	116	16.6	1	-	-	-	-	-	N	-	-	-	-	Female with eggs
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	358	LKCH	86	7.3	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	359	LKCH	96	10.9	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	360	TRPR	73	4.4	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	361	LKCH	91	8.2	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	362	LKCH	90	7.6	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	363	LKCH	85	6.9	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	Tally	FTMN	-	-	3	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	364	SLSC	56	1.3	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	365	LKCH	78	6.2	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	366	SLSC	58	1.1	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	367	LKCH	87	6.9	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	368	LKCH	75	5	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:31	440911	6361478	02-Jun-18	8:31	Minnow Trap	1 trap	MT05	369	SLSC	57	1.3	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:40	440877	6361583	02-Jun-18	9:20	Minnow Trap	1 trap	MT06	379	LKCH	73	3.7	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:40	440877	6361583	02-Jun-18	9:20	Minnow Trap	1 trap	MT06	Tally	FTMN	-	-	2	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:40	440877	6361583	02-Jun-18	9:20	Minnow Trap	1 trap	MT06	380	LKCH	90	7.9	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:42	440889	6361504	02-Jun-18	9:37	Minnow Trap	1 trap	MT07	Tally	FTMN	-	-	3	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:42	440889	6361504	02-Jun-18	9:37	Minnow Trap	1 trap	MT07	381	LKCH	82	5.8	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:42	440889	6361504	02-Jun-18	9:37	Minnow Trap	1 trap	MT07	382	LKCH	51	1.1	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	371	LKCH	130	24.35	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	372	LKCH	123	18.2	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	373	LKCH	110	17.2	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	374	LKCH	119	17.7	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	375	LKCH	87	5.7	1	-	-	-	-	-	N	-	-	-	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	376	LKCH	115	19.7	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	377	LKCH	87	6.1	1	-	-	-	-	-	N	-	-	-	-	
01-Jun-18	14:29	440894	6361555	02-Jun-18	9:14	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
02-Jun-18	8:31	440909	6361483	02-Jun-18	14:14	Minnow Trap	1 trap	MT01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
02-Jun-18	8:50	440893	6361505	02-Jun-18	14:15	Minnow Trap	1 trap	MT02	Tally	FTMN	-	-	5	-	-	-	-	-	N	-	-	-	-	
02-Jun-18	9:11	440894	6361517	02-Jun-18	14:22	Minnow Trap	1 trap	MT03	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
02-Jun-18	9:14	440900	6361537	02-Jun-18	14:27	Minnow Trap	1 trap	MT04	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
02-Jun-18	8:33	440911	6361478	02-Jun-18	14:12	Minnow Trap	1 trap	MT05	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish
02-Jun-18	9:21	440877	6361583	02-Jun-18	14:30	Minnow Trap	1 trap	MT06	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
02-Jun-18	9:38	440889	6361504	02-Jun-18	14:20	Minnow Trap	1 trap	MT07	Tally	FTMN	-	-	1	-	-	-	-	-	N	-	-	-	-	
02-Jun-18	8:51	440903	6361497	02-Jun-18	14:18	Fyke Net	1 net	FYKE01	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
02-Jun-18	9:15	440894	6361555	02-Jun-18	14:32	Fyke Net	1 net	FYKE02	-	-	-	-	0	-	-	-	-	-	N	-	-	-	-	No fish.
14-May-18	17:25	440894	6361555	15-May-18	9:30	Fyke Net	1 net	FYKE02	1	ARGR	295	296	1	A	M	U	-	-	N	-	-	N	-	Cut to right side of head, did not sample or install tag due to injury (see photos)
14-May-18	17:25	440894	6361555	15-May-18	9:30	Fyke Net	1 net	FYKE02	2	ARGR	82	3.7	1	J	IM	U	-	-	N	-	-	N	-	
15-May-18	16:25	440903	6361497	16-May-18	8:55	Fyke Net	1 net	FYKE01	7	ARGR	80	4	1	J	IM	U	-	-	N	-	-	N	-	
22-May-18	12:20	440903	6361497	22-May-18	16:25	Fyke Net	1 net	FYKE01	23	WHSC	313	338	1	A	M	U	FR	PIT	N	-	989001004 080257	N	3	
22-May-18	12:20	440903	6361497	22-May-18	16:25	Fyke Net	1 net	FYKE01	24	WHSC	323	422	1	A	M	U	FR	PIT	N	-	989001004 080206	N	3	Mottled skin (photos).
22-May-18	12:20	440903	6361497	22-May-18	16:25	Fyke Net	1 net	FYKE01	25	WHSC	415	822	1	A	M	U	FR	PIT	Y	985121017 901035	-	N	9	Damaged caudal. Recap but not previous record of tag number
22-May-18	12:20	440903	6361497	22-May-18	16:25	Fyke Net	1 net	FYKE01	26	WHSC	455	1148	1	A	M	F	FR	PIT	N	-	989001004 080444	N	10	Eggs
22-May-18	12:05	440909	6361483	22-May-18	16:06	Minnow Trap	1 trap	MT01	44	WHSC	82	7.1	1	J	IM	U	-	-	N	-	-	N	-	
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	206	WHSC	247	196	1	A	U	U	FR	PIT	N	-	989001004 080244	N	6	Left pectoral fin with parasites.
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	207	LNSC	316	353	1	A	M	M	FR	PIT	N	-	989001004 080254	N	7	Tubercles, left gill parasite.
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	208	LNSC	261	208	1	A	M	M	FR	PIT	N	-	989001004 080213	N	8	Tubercles, milt.
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	209	LNSC	285	243	1	A	M	U	FR	PIT	N	-	989001004 080253	N	6	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	210	LNSC	357	438	1	A	M	U	-	PIT	Y	985120028 265344	-	N	-	Torn caudal. Initially tagged August 11, 2010 at HZL (LNSC, 250 mm, 190 g)
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	211	WHSC	298	335	1	A	M	U	FR	PIT	N	-	989001004 080196	Y	6	Parasites on pelvic fins, tapeworm from anus.
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	212	LNSC	270	215	1	A	M	M	FR	PIT	N	-	989001004 080249	Y	6	Tubercles, milt.
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	213	LNSC	247	166	1	A	M	F	FR	PIT	N	-	989001004 080239	N	6	Missing left operculum, eggs.
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	214	WHSC	274	228	1	A	M	U	FR	PIT	N	-	989001004 080170	N	6	
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	215	WHSC	246	177.5	1	A	M	U	FR	PIT	N	-	989001004 080179	N	6	
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	216	LNSC	295	301	1	A	M	F	FR	PIT	N	-	989001004 080188	N	7	Leech on left pelvic fin, eggs.
22-May-18	16:27	440903	6361497	23-May-18	11:20	Fyke Net	1 net	FYKE01	217	WHSC	281	261.5	1	A	M	U	FR	PIT	N	-	989001004 080259	N	7	
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	237	WHSC	291	318	1	A	M	F	FR	PIT	N	-	989001004 080234	N	7	Eggs.
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	238	LNSC	240	349	1	A	M	M	-	PIT	N	-	989001004 080225	Y	-	Severe damage to posterior, tubercles, milt
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	239	WHSC	360	571	1	A	M	F	FR	PIT	N	-	989001004 080242	Y	7	Eggs.
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	240	WHSC	331	447	1	A	M	M	-	PIT	N	-	989001004 080219	Y	-	Parasites on fins.
23-May-18	11:16	440903	6361497	23-May-18	15:50	Fyke Net	1 net	FYKE01	244	WHSC	40	0.4	1	J	IM	U	-	-	N	-	-	N	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	270	WHSC	74	4.1	1	J	IM	U	-	-	N	-	-	N	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	271	WHSC	67	3	1	J	IM	U	-	-	N	-	-	N	-	
23-May-18	15:25	440894	6361517	24-May-18	10:35	Minnow Trap	1 trap	MT03	272	WHSC	68	3.3	1	J	IM	U	-	-	N	-	-	N	-	
23-May-18	15:26	440909	6361483	24-May-18	11:18	Minnow Trap	1 trap	MT01	285	WHSC	67	2.6	1	J	IM	U	-	-	N	-	-	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	285	WHSC	350	496	1	A	M	F	-	PIT	Y	989001004 739191 and 989001004 080405	-	N	-	Recap from 1-Jun-17. Tagged a second time by accident.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	286	LNSC	274	236	1	A	M	U	FR	PIT	N	-	989001004 080400	N	7	Scarring.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	287	LNSC	320	325	1	A	M	M	FR	PIT	N	-	989001004 080171	N	6	Milt, tubercles.

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	288	LNSC	286	245.5	1	A	M	M	-	PIT	N	-	989001004 080193	N	-	Milt, tubercles.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	289	LNSC	295	301.5	1	A	M	U	-	PIT	N	-	989001004 080459	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	290	LNSC	273	211	1	A	M	M	-	PIT	N	-	989001004 080189	N	-	Scarring on right side.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	291	LNSC	276	222	1	A	M	M	-	PIT	N	-	989001004 080227	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	292	LNSC	324	335	1	A	M	U	FR	PIT	N	-	989001004 080200	N	6	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	293	LNSC	310	312	1	A	M	F	FR	PIT	N	-	989001004 080415	N	7	Eggs
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	294	LNSC	301	281	1	A	M	U	FR	PIT	N	-	989001004 080441	N	7	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	295	LNSC	256	157	1	A	M	M	-	PIT	N	-	989001004 080166	N	-	Tubercles, milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	296	WHSC	312	350	1	A	M	U	-	PIT	N	-	989001004 080190	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	297	LNSC	286	256.5	1	A	M	M	-	PIT	N	-	989001004 738834	N	-	Milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	298	LNSC	256	206.5	1	A	M	M	-	PIT	N	-	989001004 738844	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	299	LNSC	278	223.5	1	A	M	M	-	PIT	N	-	989001004 738872	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	300	LNSC	295	303.5	1	A	M	F	-	PIT	N	-	989001004 738833	N	-	Scarring on left side, eggs.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	301	LNSC	345	428.5	1	A	M	M	-	PIT	N	-	989001004 738836	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	302	LNSC	335	342	1	A	M	U	-	PIT	Y	900236000 186484	-	N	-	Initially tagged May 29, 2013 at TAR (LNSC, 314 mm, 305 g)
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	303	WHSC	214	115.5	1	A	M	U	FR	PIT	N	-	989001004 738828	N	5	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	304	WHSC	273	284	1	A	M	U	FR	PIT	N	-	989001004 738773	N	6	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	305	WHSC	388	796	1	A	M	F	FR	PIT	N	-	989001004 738853	N	10	Eggs.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	306	WHSC	285	273	1	A	M	U	-	PIT	N	-	989001004 738866	N	-	

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	307	LNSC	300	310	1	A	M	M	-	PIT	N	-	989001004 738783	N	-	Milt
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	308	WHSC	319	368	1	A	M	U	-	PIT	N	-	989001004 738782	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	309	LNSC	330	424	1	A	M	F	-	PIT	N	-	989001004 738785	N	-	Eggs.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	310	LNSC	290	265.5	1	A	M	U	-	PIT	N	-	989001004 738815	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	311	LNSC	325	361.6	1	A	M	U	-	PIT	Y	900236000 186825	-	N	-	Initially tagged May 30, 2013 at TAR (LNSC, 313 mm, 302 g).
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	312	LNSC	312	301	1	A	M	M	-	PIT	N	-	989001004 738777	N	-	Scarring on left side, milt, damage to right pectoral
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	313	WHSC	294	294	1	A	M	F	-	PIT	N	-	989001004 738774	N	-	Eggs.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	314	LNSC	315	364	1	A	M	M	-	PIT	N	-	989001004 738861	N	-	Milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	315	WHSC	216	103.5	1	A	M	U	FR	PIT	N	-	989001004 738780	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	316	LNSC	283	238	1	A	M	F	FR	PIT	Y	989001001 689262		N	5	Eggs. Initially tagged Oct 19, 2015 at HZL (LNSC, 275 mm, 275 5 g)
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	317	WHSC	287	256	1	A	M	U	-	PIT	N	-	989001004 738811	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	318	WHSC	179	61	1	A	M	M	-	PIT	N	-	989001004 738831	N	-	Tubercles, milt, torn dorsal.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	319	WHSC	250	207.5	1	A	M	U	-	PIT	N	-	989001004 738814	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	320	WHSC	320	417	1	A	M	U	-	PIT	N	-	989001004 738837	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	321	LNSC	297	286.5	1	A	M	U	-	PIT	N	-	989001004 738848	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	322	WHSC	335	437	1	A	M	U	-	PIT	N	-	989001004 739193	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	323	LNSC	295	285	1	A	M	U	-	PIT	N	-	989001004 739225	N	-	Torn caudal, scarring on sides.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	324	WHSC	237	186.5	1	A	M	U	-	PIT	N	-	989001004 739182	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	325	LNSC	292	284.5	1	A	M	M	-	PIT	N	-	989001004 738847	N	-	Milt.

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	326	WHSC	330	372.5	1	A	M	U	-	PIT	N	-	989001004 738870	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	327	WHSC	262	212	1	A	M	U	-	PIT	N	-	989001004 738797	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	328	WHSC	341	409.5	1	A	M	U	-	PIT	N	-	989001004 738795	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	329	LNSC	312	313.5	1	A	M	U	-	PIT	N	-	989001004 739243	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	330	WHSC	272	261.5	1	A	M	U	-	PIT	N	-	989001004 738788	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	331	WHSC	320	351.5	1	A	M	U	-	PIT	N	-	989001004 739207	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	332	LNSC	284	246.5	1	A	M	M	-	PIT	N	-	989001004 739178	N	-	Milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	333	LNSC	275	201.5	1	A	M	M	-	PIT	N	-	989001004 738808	N	-	Milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	334	LNSC	340	439	1	A	M	F	-	PIT	N	-	989001004 739240	N	-	Eggs
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	335	LNSC	300	257.5	1	A	M	M	-	PIT	N	-	989001004 738858	N	-	Milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	336	LNSC	288	248.5	1	A	M	F	-	PIT	N	-	989001004 739194	N	-	Eggs.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	337	LNSC	250	168.5	1	A	M	M	FR	PIT	N	-	989001004 739203	N	6	Milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	338	LNSC	272	218.5	1	A	M	M	-	PIT	N	-	989001004 739179	N	-	Milt.
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	339	LNSC	279	230.5	1	A	M	M	-	PIT	N	-	989001004 739211	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	340	WHSC	321	401.5	1	A	M	U	-	PIT	N	-	989001004 739184	N	-	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	341	WHSC	218	119	1	A	M	U	FR	PIT	N	-	989001004 739234	N	5	
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	342	LNSC	284	247	1	A	M	M	-	PIT	N	-	989001004 739180	N	-	Milt
23-May-18	15:26	440903	6361497	24-May-18	11:18	Fyke Net	1 net	FYKE01	343	WHSC	304	296.5	1	A	M	U	-	PIT	N	-	989001004 739181	N	-	
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	345	WHSC	237	186.5	1	A	M	U	-	PIT	N	989001004 739182	-	N	-	Recap from AM.

Table A4.10 (Cont'd.)

Start Date	Start Time	UTM E	UTM N	End Date	End Time	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Age	Comments
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	346	LNSC	280	250	1	A	U	U	-	PIT	N	-	989001004 739221	N	-	
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	347	LNSC	295	285	1	A	M	U	-	PIT	N	989001004 739225	-	N	-	Recap from AM.
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	348	LNSC	275	201.5	1	A	M	M	-	PIT	N	989001004 738808		N	-	Recap from AM.
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	349	LNSC	284	246.5	1	A	M	M	-	PIT	N	989001004 739178		N	-	Recap from AM.
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	350	WHSC	272	261.5	1	A	M	U	-	PIT	N	989001004 738788		N	-	Recap from AM
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	351	LNSC	330	424	1	A	M	F	-	PIT	N	989001004 738785		N	-	Recap from AM
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	352	LNSC	250	168.5	1	A	M	M	FR	PIT	N	989001004 739203		N	-	Recap from AM
24-May-18	11:52	440903	6361497	24-May-18	15:03	Fyke Net	1 net	FYKE01	353	LNSC	272	218.5	1	A	M	M	-	PIT	N	989001004 739179		N	-	Recap from AM.
29-May-18	14:14	440903	6361497	30-May-18	9:40	Fyke Net	1 net	FYKE01	355	ARGR	170	41.2	1	A	M	U	-	PIT	N	-	989001004 739241	N	-	
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	370	WHSC	322	415	1	A	M	F	-	PIT	N	-	989001004 739213	N	-	Female with eggs, torn dorsal.
01-Jun-18	14:27	440903	6361497	02-Jun-18	8:50	Fyke Net	1 net	FYKE01	378	ARGR	171	51.8	1	A	M	U	FR	PIT	N	-	989001004 739254	N	-	Fin ray for genetic.
01-Jun-18	14:42	440889	6361504	02-Jun-18	9:37	Minnow Trap	1 trap	MT07	382	WHSC	74	35	1	A	M	U	-	-	N	-	-	N	-	

Table A4.11 Fish captured during the fall fish program at Horizon Lake, October 2018.

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
3-Oct-18	15:52	0441345	6361390	3-Oct-18	17:35	0441400	6361404	Gillnet	Net of 8 pannels.	I30	1	ARGR	166	35	1	-	-	-	-	PIT	N	-	9890010047 39230	N	N	-	Wound on dorsal. Tagged.
3-Oct-18	15:52	0441345	6361390	3-Oct-18	17:35	0441400	6361404	Gillnet	Net of 8 pannels.	I30	2	ARGR	162	41	1	-	-	F	-	-	N	-	-	N	N	-	Female.
3-Oct-18	15:52	0441345	6361390	3-Oct-18	17:35	0441400	6361404	Gillnet	Net of 8 pannels.	I30	3	ARGR	175	31	1	-	-	-	-	PIT	N	-	9890010040 80218	N	N	-	Split caudal. Tagged
3-Oct-18	15:52	0441345	6361390	3-Oct-18	17:35	0441400	6361404	Gillnet	Net of 8 pannels.	I30	4	ARGR	170	28	1	-	-	-	-	PIT	N	-	9890010040 80451	N	N	-	
3-Oct-18	15:52	0441345	6361390	3-Oct-18	17:35	0441400	6361404	Gillnet	Net of 8 pannels.	I30	5	ARGR	161	44	1	-	-	-	-	PIT	N	-	9890010040 80448	N	N	-	Split caudal. Tagged
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps	S1	9	BRST	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	10	TRPR	71	4	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	11	TRPR	68	3	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	12	TRPR	67	4	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	13	TRPR	67	3	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	14	TRPR	74	4	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	15	TRPR	69	3	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	16	WHSC	96	9	1	-	-	-	FR	-	N	-	-	N	N	1	Ageing structure taken.
3-Oct-18	13:20	0441524	6361425	4-Oct-18	9:25	-	-	Minnow Trap	5 traps.	S1	17	WHSC	121	18	1	-	-	-	FR	-	N	-	-	N	N	2	Ageing structure taken
3-Oct-18	13:10	0441324	6361368	4-Oct-18	9:15	-	-	Minnow Trap	5 traps.	S22	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	6	TRPR	89	6	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	7	TRPR	74	3	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	8	TRPR	74	4	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	41	FTMN	69	3	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	42	BRST	65	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	43	BRST	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	44	BRST	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	45	FTMN	46	1	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	46	BRST	49	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	47	FTMN	44	1	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	48	FTMN	44	1	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	49	FTMN	56	2	1	-	-	-	FR	-	N	-	-	N	N	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	50	FTMN	49	1	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	51	FTMN	42	1	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	52	FTMN	44	1	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	53	FTMN	64	3	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	54	BRST	58	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	55	FTMN	60	2	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	56	FTMN	54	2	1	-	-	-	FR	-	N	-	-	N	N	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	57	BRST	62	2	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	58	FTMN	42	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	59	FTMN	56	2	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	60	FTMN	49	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	61	FTMN	44	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	62	FTMN	59	2	1	-	-	-	FR	-	N	-	-	N	N	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	63	FTMN	65	3	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	64	FTMN	55	2	1	-	-	-	FR	-	N	-	-	N	N	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps	S5	65	FTMN	56	2	1	-	-	-	FR	-	N	-	-	N	N	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	66	FTMN	63	3	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	67	BRST	65	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	68	FTMN	59	2	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps	S5	69	FTMN	59	2	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	70	FTMN	64	3	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	71	FTMN	43	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	72	FTMN	62	2	1	-	-	-	FR	-	N	-	-	N	L	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	74	FTMN	44	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	75	FTMN	41	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	76	FTMN	41	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	77	FTMN	42	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	78	FTMN	47	1	1	-	-	-	-	-	N	-	-	N	N		
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	79	FTMN	71	4	1	-	-	-	FR	-	N	-	-	N	N	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	80	FTMN	58	2	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	81	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	82	FTMN	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	83	FTMN	65	3	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	84	FTMN	43	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps	S5	85	BRST	57	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	86	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	87	FTMN	41	1	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:40	0441412	6360940	4-Oct-18	9:30	-	-	Minnow Trap	4 traps.	S5	88	FTMN	61	2	1	-	-	-	FR	-	N	-	-	N	L	2	
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps.	S8	18	TRPR	75	4	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps.	S8	19	TRPR	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13.55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps	S8	20	TRPR	76	5	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps.	S8	21	BRST	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps.	S8	22	FTMN	44	1	1	-	-	-	FR	-	N	-	-	N	N	1	Ageing structure taken.
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps.	S8	23	FTMN	64	3	1	-	-	-	FR	-	N	-	-	N	L	2	Composite.
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps.	S8	24	FTMN	42	1	1	-	-	-	FR	-	N	-	-	N	L	1	
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps.	S8	25	FTMN	41	1	1	-	-	-	FR	-	N	-	-	N	N	1	
3-Oct-18	13:55	0441980	6360394	4-Oct-18	9:39	-	-	Minnow Trap	4 traps	S8	26	FTMN	41	1	1	-	-	-	FR	-	N	-	-	N	N	1	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
4-Oct-18	14:39	0442686	6360790	5-Oct-18	14:21	-	-	Fyke Net		S13	178	TRPR	72	3	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	14:39	0442686	6360790	5-Oct-18	14:21	-	-	Fyke Net		S13	179	FTMN	28	0	1	-	-	-	FR	-	N	-	-	N	N	ua	
4-Oct-18	14:39	0442686	6360790	5-Oct-18	14:21	-	-	Fyke Net		S13	180	TRPR	70	4	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:50	0442143	6361212	5-Oct-18	15:20	-	-	Fyke Net		S20	181	TRPR	76	5	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:50	0442143	6361212	5-Oct-18	15:20	-	-	Fyke Net		S20	182	TRPR	82	6	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:50	0442143	6361212	5-Oct-18	15:20	-	-	Fyke Net		S20	183	TRPR	79	4	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:50	0442143	6361212	5-Oct-18	15:20	-	-	Fyke Net		S20	184	TRPR	84	6	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:50	0442143	6361212	5-Oct-18	15:20	-	-	Fyke Net		S20	185	TRPR	72	3	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	11:39	0441492	6361310	4-Oct-18	13:21	0441442	6361357	Gillnet	Net of 8 pannels.	I13	34	ARGR	167	45	1	-	-	-	-	PIT	N	-	989001004080407	N	N	-	
4-Oct-18	11:39	0441492	6361310	4-Oct-18	13:21	0441442	6361357	Gillnet	Net of 8 pannels.	I13	35	ARGR	184	60	1	-	-	-	-	PIT	N	-	989001004080412	N	N	-	
4-Oct-18	11:39	0441492	6361310	4-Oct-18	13:21	0441442	6361357	Gillnet	Net of 8 pannels.	I13	38	WHSC	249	181	1	-	-	-	FR	PIT	N	-	989001004739268	N	N	6	
4-Oct-18	11:39	0441492	6361310	4-Oct-18	13:21	0441442	6361357	Gillnet	Net of 8 pannels.	I13	39	WHSC	191	82	1	-	-	-	FR	PIT	N	-	989001004080204	N	N	4	
4-Oct-18	11:39	0441492	6361310	4-Oct-18	13:21	0441442	6361357	Gillnet	Net of 8 pannels.	I13	40	LKCH	86	8	1	-	-	-	FR	-	N	-	-	Y	N	1	
4-Oct-18	13:34	0441379	6361309	4-Oct-18	15:15	0441396	6361369	Gillnet	Net of 8 pannels.	I24	73	ARGR	165	41	1	-	-	-	-	PIT	N	-	989001004739206	N	N	-	
4-Oct-18	13:34	0441379	6361309	4-Oct-18	15:15	0441396	6361369	Gillnet	Net of 8 pannels.	I24	89	WHSC	245	171	1	-	-	-	FR	PIT	N	-	989001004739272	N	N	5	
4-Oct-18	11:01	0442087	6360604	4-Oct-18	12:50	0442034	6360566	Gillnet	Net of 8 pannels.	I5	27	WHSC	248	169	1	-	IM	F	FR/OT	-	N	-	-	N	L	7	Otoligh age = 7, Fin Ray age = 5.
4-Oct-18	11:01	0442087	6360604	4-Oct-18	12:50	0442034	6360566	Gillnet	Net of 8 pannels.	I5	29	ARGR	248	172	1	-	-	-	SC	PIT	N	-	989001004080425	N	N	3	
4-Oct-18	11:01	0442087	6360604	4-Oct-18	12:50	0442034	6360566	Gillnet	Net of 8 pannels.	I5	30	ARGR	-	-	1	-	-	-	-	-	N	-	-	N	N	-	Released to minimize stress.
4-Oct-18	11:01	0442087	6360604	4-Oct-18	12:50	0442034	6360566	Gillnet	Net of 8 pannels.	I5	31	ARGR	244	180	1	-	-	-	SC	PIT	N	-	989001004080401	N	N	3	
4-Oct-18	11:01	0442087	6360604	4-Oct-18	12:50	0442034	6360566	Gillnet	Net of 8 pannels.	I5	36	WHSC	160	46	1	-	-	-	FR	PIT	N	-	989001004080431	N	N	2	Hemorrhaging near mouth and caudal.
4-Oct-18	11:01	0442087	6360604	4-Oct-18	12:50	0442034	6360566	Gillnet	Net of 8 pannels.	I5	37	WHSC	251	157	1	-	IM	F	FR	-	N	-	-	N	L	5	
4-Oct-18	10:07	0442353	6361010	4-Oct-18	11:12	0442404	6361039	Gillnet	Net of 8 pannels.	S15	28	WHSC	215	104	1	-	-	F	FR	-	N	-	-	N	L	4	Hemorrhaging around fins.
4-Oct-18	10:07	0442353	6361010	4-Oct-18	11:12	0442404	6361039	Gillnet	Net of 8 pannels.	S15	32	WHSC	215	105	1	-	-	-	FR	PIT	N	-	989001004080430	N	N	5	Hemorrhaging on ventral and fins.
4-Oct-18	10:07	0442353	6361010	4-Oct-18	11:12	0442404	6361039	Gillnet	Net of 8 pannels.	S15	33	WHSC	221	127	1	-	IM	M	FR/OT	-	N	-	-	N	L	7	Hemorrhaging on fins. Otoligh age = 7, fin ray age = 5.
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed.	S12	160	TRPR	74	5	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed	S12	161	BRST	64	6	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed.	S12	162	BRST	64	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed	S12	163	TRPR	72	5	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed.	S12	164	TRPR	62	3	1	-	-	-	-	-	N	-	-	N	N		
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed	S12	165	BRST	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed.	S12	166	BRST	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:38	0441475	6360815	5-Oct-18	9:47	-	-	Minnow Trap	5 traps deployed.	S12	167	BRST	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	13:44	0441330	6361445	5-Oct-18	9:37	-	-	Minnow Trap	5 traps.	S23	90	BRST	53	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	13:44	0441330	6361445	5-Oct-18	9:37	-	-	Minnow Trap	5 traps.	S23	91	FTMN	67	4	1	-	-	-	FR	-	N	-	-	N	N	2	
4-Oct-18	13:44	0441330	6361445	5-Oct-18	9:37	-	-	Minnow Trap	5 traps.	S23	92	TRPR	72	5	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	13:44	0441330	6361445	5-Oct-18	9:37	-	-	Minnow Trap	5 traps.	S23	93	FTMN	31	0	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	13:44	0441330	6361445	5-Oct-18	9:37	-	-	Minnow Trap	5 traps.	S23	94	FTMN	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	13:44	0441330	6361445	5-Oct-18	9:37	-	-	Minnow Trap	5 traps.	S23	95	FTMN	35	1	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	13:41	0441407	6361440	5-Oct-18	9:30	-	-	Minnow Trap	5 traps deployed.	S30	157	BRST	64	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	13:41	0441407	6361440	5-Oct-18	9:30	-	-	Minnow Trap	5 traps deployed	S30	158	TRPR	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	13:41	0441407	6361440	5-Oct-18	9:30	-	-	Minnow Trap	5 traps deployed	S30	159	TRPR	67	3	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed	S4	144	TRPR	71	4	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed	S4	145	BRST	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed.	S4	146	FTMN	61	4	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed.	S4	147	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed	S4	148	TRPR	71	4	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed.	S4	149	TRPR	66	4	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed	S4	150	FTMN	56	4	1	-	-	-	-	-	N	-	-	N	N		
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed.	S4	151	FTMN	68	4	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed	S4	152	BRST	56	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed	S4	153	BRST	58	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed.	S4	154	LKCH	94	10	1	-	-	-	FR	-	N	-	-	Y	L	1	Composite (m + o).
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed	S4	155	BRST	63	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	15:35	0442110	6361194	5-Oct-18	9:57	-	-	Minnow Trap	5 traps deployed.	S4	156	BRST	55	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	96	BRST	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	97	FTMN	37	1	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	98	FTMN	41	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	99	FTMN	44	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	100	FTMN	39	1	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	101	FTMN	60	2	1	-	-	-	-	-	N	-	-	N	L	-	Composite (m + o).
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	102	FTMN	38	1	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	103	BRST	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	104	BRST	55	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	105	BRST	63	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	106	FTMN	68	3	1	-	-	-	-	-	N	-	-	N	L	-	Composite (m + o).
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	107	BRST	52	1	1	-	-	-	-	-	N	-	-	N	N		
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	108	FTMN	38	1	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	109	FTMN	51	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	110	BRST	54	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	111	FTMN	45	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	112	FTMN	41	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	113	FTMN	45	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	114	FTMN	41	1	1	-	-	-	-	-	N	-	-	N	N		
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	115	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	116	FTMN	40	1	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	117	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	L	-	Composite (Hg).
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	118	FTMN	42	1	1	-	-	-	-	-	N	-	-	N	N		
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	119	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	L	-	Composite (Hg).
4-Oct-18	12:30	0442050	6360475	5-Oct-18	10:05	-	-	Minnow Trap	5 traps set.	S7	120	FTMN	40	1	1	-	-	-	FR	-	N	-	-	N	N	0	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	121	FTMN	70	4	1	-	-	-	-	-	N	-	-	N	L	-	Composite (Hg).
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set	S9	122	BRST	58	2	1	-	-	-	-	-	N	-	-	N	N		
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	123	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	124	BRST	59	1	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	125	BRST	54	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	126	BRST	55	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	127	BRST	51	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	128	BRST	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	129	FTMN	71	4	1	-	-	-	FR	-	N	-	-	N	N	2	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	130	TRPR	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	131	FTMN	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	132	BRST	54	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	133	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	L	-	Composite (m + o).
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	134	FTMN	50	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	135	BRST	64	2	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	136	BRST	55	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	137	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	L	-	Composite (m + o).
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	138	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	L	-	Composite (m + o).
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	139	FTMN	45	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	140	FTMN	72	5	1	-	-	-	FR	-	N	-	-	N	N	2	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	141	FTMN	43	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct 18	10:10	-	-	Minnow Trap	5 traps set.	S9	142	BRST	55	1	1	-	-	-	-	-	N	-	-	N	N	-	
4-Oct-18	12:27	0442086	6360437	5-Oct-18	10:10	-	-	Minnow Trap	5 traps set.	S9	143	TRPR	64	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	17:05	0442373	6361185	6-Oct-18	15:20	-	-	Fyke Net		S19	352	FTMN	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	17:05	0442373	6361185	6-Oct-18	15:20	-	-	Fyke Net		S19	353	TRPR	75	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	17:05	0442373	6361185	6-Oct-18	15:20	-	-	Fyke Net		S19	354	FTMN	63	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	17:05	0442373	6361185	6-Oct-18	15:20	-	-	Fyke Net		S19	355	FTMN	37	1	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	17:05	0442373	6361185	6-Oct-18	15:20	-	-	Fyke Net		S19	356	FTMN	70	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	17:05	0442373	6361185	6-Oct-18	15:20	-	-	Fyke Net		S19	357	FTMN	32	0	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	17:05	0442373	6361185	6-Oct-18	15:20	-	-	Fyke Net		S19	358	BRST	52	1	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	16:51	0442115	6360395	6-Oct-18	16:00	-	-	Fyke Net		S9	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
5-Oct-18	11:36	0442047	6360787	5-Oct-18	13:30	0442100	6360823	Gillnet	Net of 8 pannels.	D10	171	LNSC	173	74	1	-	-	-	FR	PIT	N	-	9890010040 80236	N	N	2	
5-Oct-18	15:45	0442383	6360548	5-Oct-18	17:23	0442368	6360489	Gillnet	Net of 8 pannels.	D3	188	ARGR	261	225	1	-	-	-	SC	PIT	N	-	9890010047 39222	N	N	3	
5-Oct-18	13:45	0441944	6360613	5-Oct-18	15:37	0442019	6360391	Gillnet	Net of 8 pannels	D5	186	LKCH	146	44	1	-	-	-	FR	-	N	-	-	Y	N	4	
5-Oct-18	13:45	0441944	6360613	5-Oct-18	15:37	0442019	6360391	Gillnet	Net of 8 pannels.	D5	187	WHSC	180	60	1	-	-	-	FR	PIT	N	-	9890010047 39259	N	N	4	
5-Oct-18	14:10	0441643	6361025	5-Oct-18	15:54	0441609	6361071	Gillnet	Net of 8 pannels.	I22	177	ARGR	147	51	1	-	-	-	-	-	N	-	-	N	N	-	Released immediately.
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels.	I23	168	ARGR	281	302	1	-	-	M	SC	PIT	N	-	9890010040 80366	N	N	3	Male.

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels.	I23	169	WHSC	230	122	1	-	-	-	FR	-	N	-	-	N	N	5	No PIT due to lethargy.
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels.	I23	170	WHSC	150	46	1	-	-	-	FR	PIT	N	-	9890010047 39267	N	N	2	
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels.	I23	172	WHSC	164	52	1	-	-	-	FR	PIT	N	-	9890010047 39202	N	N	2	
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels.	I23	173	WHSC	233	160	1	-	-	-	FR	PIT	N	-	9890010047 39266	N	N	5	
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels.	I23	174	WHSC	82	9	1	-	-	-	FR	-	N	-	-	Y	L	1	Composite (m + o).
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels	I23	175	WHSC	281	251	1	-	M	F	FR	-	N	-	-	N	L	8	
5-Oct-18	12:15	0441618	6360876	5-Oct-18	13:55	0441582	6360928	Gillnet	Net of 8 pannels	I23	176	WHSC	255	193	1	-	-	F	FR	-	N	-	-	N	L	4	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	189	ARGR	282	305	1	-	-	-	SC	PIT	N	-	9890010040 80165	N	N	3	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	190	ARGR	314	350	1	-	-	-	SC	PIT	N	-	9890010047 39215	N	N	3	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	191	WHSC	105	14	1	-	-	-	FR	-	N	-	-	N	N	1	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	192	WHSC	96	11	1	-	-	-	FR	-	N	-	-	N	L	3	Composite (o + m)
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	193	WHSC	206	98	1	-	-	-	FR	PIT	N	-	9890010047 39237	N	N	5	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	194	WHSC	225	120	1	-	-	-	FR	PIT	N	-	9890010047 39232	N	N	5	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	195	WHSC	235	158	1	-	-	-	FR	PIT	N	-	9890010047 39246	N	N	8	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	196	WHSC	98	13	1	-	-	-	FR	-	N	-	-	N	L	2	Composite (o + m)
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	197	WHSC	201	93	1	-	-	-	FR	PIT	N	-	9890010047 39208	Y	N	4	
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	198	WHSC	97	11	1	-	-	-	FR	-	N	-	-	Y	L	2	Composite (o + m)
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	199	WHSC	92	10	1	-	-	-	FR	-	N	-	-	Y	L	2	Composite (o + m)
5-Oct-18	16:08	0442611	6360758	5-Oct-18	18:42	0442581	6360781	Gillnet	Net of 8 pannels.	I6	200	WHSC	422	940	1	-	-	-	FR	PIT	Y	9001180014 21834	-	N	N	9	
5-Oct-18	10:39	0441300	6361375	5-Oct-18	12:05	0441368	6361399	Gillnet	Net of 8 pannels.	S22	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
5-Oct-18	14:05	0442101	6360996	6-Oct-18	10:49	-	-	Minnow Trap	5 traps.	D24	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	No fish captured
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	201	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	202	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	203	FTMN	66	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	204	LKCH	83	7	1	-	-	-	FR	-	N	-	-	N	N	1	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	205	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	206	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	207	FTMN	66	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	208	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	209	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	210	LKCH	67	3	1	-	-	-	FR	-	N	-	-	N	N	1	
5-Oct-18	14:35	0442535	6360686	6-Oct-18	10:20	-	-	Minnow Trap	5 traps.	D8	211	TRPR	75	5	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	16:46	0442329	6360518	6-Oct-18	10:56	-	-	Minnow Trap	5 traps.	I16	340	FTMN	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	16:46	0442329	6360518	6-Oct-18	10:56	-	-	Minnow Trap	5 traps.	I16	341	LKCH	76	5	1	-	-	-	FR	-	N	-	-	Y	N	1	
5-Oct-18	16:46	0442329	6360518	6-Oct-18	10:56	-	-	Minnow Trap	5 traps.	I16	342	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	16:46	0442329	6360518	6-Oct-18	10:56	-	-	Minnow Trap	5 traps.	I16	343	LKCH	52	1	1	-	-	-	FR	-	N	-	-	N	N	0	
5-Oct-18	16:46	0442329	6360518	6-Oct-18	10:56	-	-	Minnow Trap	5 traps.	I16	344	LKCH	79	5	1	-	-	-	FR	-	N	-	-	N	N	2	
5-Oct-18	16:46	0442329	6360518	6-Oct-18	10:56	-	-	Minnow Trap	5 traps.	I16	345	BRST	35	0	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	212	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	213	FTMN	54	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	214	FTMN	67	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	215	FTMN	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	216	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	217	FTMN	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	218	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	219	FTMN	56	2	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	220	FTMN	71	4	1	-	-	-	FR	-	N	-	-	N	N	2	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	221	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	222	FTMN	54	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	223	FTMN	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	224	FTMN	72	4	1	-	-	-	FR	-	N	-	-	N	N	2	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	225	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	226	FTMN	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	227	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	228	FTMN	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	229	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	230	LKCH	76	3	1	-	-	-	FR	-	N	-	-	N	N	1	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	231	FTMN	71	4	1	-	-	-	FR	-	N	-	-	N	N	2	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	232	FTMN	66	4	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	233	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	234	FTMN	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	235	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	236	FTMN	56	3	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	237	FTMN	68	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	238	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	239	FTMN	59	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	240	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	241	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	242	FTMN	66	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	243	FTMN	44	0	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	244	FTMN	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	245	FTMN	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	246	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	247	FTMN	54	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	248	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	249	FTMN	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	250	FTMN	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	251	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	252	FTMN	61	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	253	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	254	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	255	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	256	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	257	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	258	FTMN	59	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	259	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	260	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	261	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	262	FTMN	67	4	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	263	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	264	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	265	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	266	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	267	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	268	FTMN	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	269	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	270	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	271	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	272	FTMN	66	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	273	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	274	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	275	LKCH	85	7	1	-	-	-	FR	-	N	-	-	Y	N	1	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	276	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	277	FTMN	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	278	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	279	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	280	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	281	FTMN	50	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	282	FTMN	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	283	FTMN	65	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	284	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	285	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	286	FTMN	49	1	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	287	FTMN	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	288	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	289	FTMN	67	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	290	FTMN	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	291	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	292	FTMN	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	293	BRST	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	294	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	295	FTMN	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	296	LKCH	102	12	1	-	-	-	FR		N	-	-	N	L	2	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	297	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:09	0442512	6360628	6-Oct-18	10:10	-	-	Minnow Trap	5 traps.	I18	298	LKCH	115	16	1	-	-	-	FR	-	N	-	-	N	L	4	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	299	FTMN	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	300	FTMN	43	1	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	301	TRPR	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	302	BRST	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	303	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	304	FTMN	38	1	1	-	-	-	FR	-	N	-	-	N	N	0	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	305	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	306	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	307	FTMN	52	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	308	LKCH	82	6	1	-	-	-	FR	-	N	-	-	N	N	1	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	309	BRST	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	310	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	311	FTMN	73	4	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	312	FTMN	74	5	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	313	FTMN	66	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	314	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	315	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	316	FTMN	62	2	1	-	-	-	-	-	N	-	-	N	N	-	

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Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	317	FTMN	71	4	1	-	-	-	FR	-	N	-	-	N	N	2	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	318	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	319	FTMN	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	320	BRST	66	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	321	FTMN	66	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	322	FTMN	60	2	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	323	FTMN	68	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	324	BRST	64	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	325	FTMN	39	1	1	-	-	-	FR	-	N	-	-	N	N	0	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	326	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	327	FTMN	61	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	328	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	329	FTMN	40	1	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	330	FTMN	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	331	FTMN	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	332	FTMN	53	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	333	LKCH	59	2	1	-	-	-	FR	-	N	-	-	N	N	0	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	334	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	335	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	336	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	337	FTMN	45	1	1	-	-	-	-	-	N	-	-	N	N		
5-Oct-18	13:30	0442575	6360657	6-Oct-18	10:14	-	-	Minnow Trap	5 traps.	I20	338	BRST	55	1	1	-	-	-	-	-	N	-	-	N	N	-	
5-Oct-18	13:42	0442203	6361196	6-Oct-18	10:42	-	-	Minnow Trap	5 traps.	I25	339	FTMN	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	17:23	0442600	6360618	7-Oct-18	15:23	-	-	Fyke Net		S11	422	FTMN	37	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	15:35	0442144	6361209	7-Oct-18	15:30	-	-	Fyke Net		S20	417	TRPR	70	4	1	-	-	-	-	-	N	-	-	N	N	-	Guts protruding out
6-Oct-18	15:35	0442144	6361209	7-Oct-18	15:30	-	-	Fyke Net		S20	418	FTMN	35	0	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	15:35	0442144	6361209	7-Oct-18	15:30	-	-	Fyke Net		S20	419	FTMN	36	0	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	15:35	0442144	6361209	7-Oct-18	15:30	-	-	Fyke Net		S20	420	FTMN	41	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	15:35	0442144	6361209	7-Oct-18	15:30	-	-	Fyke Net		S20	421	TRPR	79	5	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:49	0441580	6361142	6-Oct-18	15:46	0441642	6361152	Gillnet	Net of 8 pannels.	D26	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
6-Oct-18	11:36	0442122	6360505	6-Oct-18	13:30	0442070	6360546	Gillnet	Net of 8 pannels	I17	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
6-Oct-18	12:30	0442577	6360664	6-Oct-18	14:25	0442510	6360678	Gillnet	Net of 8 pannels.	I20	346	LNSC	167	52	1	-	-	-	FR	PIT	N	-	989001004739183	N	N	2	
6-Oct-18	12:30	0442577	6360664	6-Oct-18	14:25	0442510	6360678	Gillnet	Net of 8 pannels.	I20	347	WHSC	213	101	1	-	-	-	FR	PIT	N	-	989001004739244	N	N	2	
6-Oct-18	13:40	0442607	6360706	6-Oct-18	15:20	0442630	6360656	Gillnet	Net of 8 pannels.	I6	348	ARGR	307	347	1	-	-	-	SC	PIT	N	-	989001004739262	N	N	3	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
6-Oct-18	13:40	0442607	6360706	6-Oct-18	15:20	0442630	6360656	Gillnet	Net of 8 pannels.	I6	349	ARGR	310	348	1	-	-	-	SC	PIT	N	-	9890010047 39229	N	N	3	Torn caudal fin.
6-Oct-18	13:40	0442607	6360706	6-Oct-18	15:20	0442630	6360656	Gillnet	Net of 8 pannels.	I6	350	WHSC	229	146	1	-	-	-	-	PIT	N	-	9890010047 39257	N	N	-	
6-Oct-18	13:40	0442607	6360706	6-Oct-18	15:20	0442630	6360656	Gillnet	Net of 8 pannels	I6	351	WHSC	309	385	1	-	M	M	FR	-	N	-	-	N	L	6	Lethal. Duplicate.
6-Oct-18	14:31	0442300	6360737	-	-	-	-	Minnow Trap	5 traps.	D33	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	359	TRPR	74	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	360	TRPR	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	361	TRPR	72	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	362	TRPR	74	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	363	TRPR	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	364	TRPR	73	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	365	TRPR	67	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	366	TRPR	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	367	TRPR	44	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	368	TRPR	41	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	12:57	0441952	6360664	7-Oct-18	10:00	-	-	Minnow Trap	5 traps.	D4	369	TRPR	45	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	392	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	393	TRPR	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	394	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	395	BRST	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	396	BRST	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	397	FTMN	44	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	398	BRST	54	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	399	FTMN	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	400	BRST	58	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	401	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	402	BRST	55	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	403	BRST	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:01	0441864	6360771	7-Oct-18	10:36	-	-	Minnow Trap	5 traps.	I5	404	FTMN	45	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	381	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	382	FTMN	67	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	383	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	384	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	385	FTMN	66	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	386	FTMN	52	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	387	FTMN	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	388	FTMN	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	389	BRST	56	1	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
6-Oct-18	13.24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	390	FTMN	52	1	1	-	-	-	-	-	N	-	-	N	N	-	Black spots on head and tail
6-Oct-18	13:24	0442375	6361023	7-Oct-18	10:46	-	-	Minnow Trap	5 traps.	S16	391	FTMN	74	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	14:48	0442413	6361122	7-Oct-18	10:56	-	-	Minnow Trap	5 traps.	S21	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps	S6	370	BRST	50	1	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	371	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	372	FTMN	62	3	1	-	-	-	FR	-	N	-	-	N	N	1	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	373	FTMN	62	4	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	374	FTMN	64	3	1	-	-	-	FR	-	N	-	-	N	N	1	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	375	LKCH	71	6	1	-	-	-	FR	-	N	-	-	N	N	0	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	376	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N		
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	377	TRPR	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	378	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps	S6	379	FTMN	48	1	1	-	-	-	FR	-	N	-	-	N	N	1	
6-Oct-18	13:17	0442547	6360600	7-Oct-18	10:30	-	-	Minnow Trap	5 traps.	S6	380	LKCH	45	1	1	-	-	-	FR	-	N	-	-	N	N	0	Black spots on tail.
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	406	WHSC	229	119	1	-	-	-	-	PIT	N	-	9890010047 39269	N	N	-	
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	407	WHSC	240	158	1	-	-	-	-	PIT	N	-	9890010047 39219	N	N	-	
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	408	WHSC	244	181	1	-	-	-	-	PIT	N	-	9890010047 39228	Y	N	-	Parasites on caudal fin.
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	409	TRPR	70	4	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	410	TRPR	76	5	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	411	TRPR	94	6	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	412	TRPR	83	7	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz, 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	413	TRPR	83	6	1	-	-	-	-	-	N	-	-	N	N		
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	414	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz, 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	415	TRPR	83	6	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	12:19	0442646	6360676	7-Oct-18	14:00	0441548	6361414	Electrofishing	60 Hz; 60% D.C.; 5 Amps; 80% Power.	Perimeter of Horizon Lake	416	TRPR	82	6	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:18	0441958	6360472	8-Oct-18	15:21	-	-	Fyke Net		S27	464	FTMN	54	2	1	-	-	-	-	-	N	-	-	N	N	-	Fyke nets frozen. Fish very lethargic
7-Oct-18	15:53	0442013	6360364	8-Oct-18	15:10	-	-	Fyke Net		S8	463	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	Fyke nets frozen. Fish very lethargic Recorded as Station ID "S4" on fish inventory datasheet, changed to S8 to correspond with Fishing Effort Datasheets.
7-Oct-18	11:52	0442212	6361143	7-Oct-18	13:31	0442272	6361118	Gillnet	Net of 8 pannels.	I10	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
7-Oct-18	9:20	0441538	6361204	7-Oct-18	11:17	0441580	6361247	Gillnet	Net of 8 pannels.	I14	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
7-Oct-18	9:03	0442240	6360521	7-Oct-18	10:58	0442168	6360524	Gillnet	Net of 8 pannels	I3	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
7-Oct-18	12:40	0442089	6360537	7-Oct-18	14:35	0442151	6360531	Gillnet	Net of 8 pannels.	S10	405	ARGR	254	196	1	-	-	-	-	PIT	N	-	989001004739190	N	N	-	
7-Oct-18	17:21	0442238	6360910	8-Oct-18	13:58	-	-	Minnow Trap	5 traps.	D18	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	438	TRPR	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	439	TRPR	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	440	TRPR	74	4	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	441	TRPR	66	4	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	442	TRPR	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	443	FTMN	82	6	1	-	-	-	FR	-	N	-	-	N	N	2	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	444	WHSC	131	24	1	-	-	-	FR	PIT	N	-	989001004739083	N	N	2	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	445	FTMN	73	5	1	-	-	-	FR	-	N	-	-	N	N	2	
7-Oct-18	17:02	0441859	6361039	8-Oct-18	12:12	-	-	Minnow Trap	5 traps.	D23	446	WHSC	102	12	1	-	-	-	FR	-	N	-	-	N	L	2	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	450	TRPR	59	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	451	TRPR	78	5	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	452	TRPR	81	5	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	453	TRPR	66	4	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	454	TRPR	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	455	FTMN	33	0	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	456	TRPR	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:53	0441487	6361345	8-Oct-18	11:59	-	-	Minnow Trap	5 traps.	I1	457	FTMN	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:38	0441542	6361022	8-Oct-18	9:30	-	-	Minnow Trap	5 traps.	I26	430	FTMN	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:38	0441542	6361022	8-Oct-18	9:30	-	-	Minnow Trap	5 traps.	I26	431	FTMN	40	1	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:38	0441542	6361022	8-Oct-18	9:30	-	-	Minnow Trap	5 traps.	I26	432	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	423	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	424	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	425	FTMN	66	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	426	FTMN	60	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	426-2	FTMN	79	4	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	427	FTMN	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	428	FTMN	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	16:46	0441544	6361111	8-Oct-18	9:40	-	-	Minnow Trap	5 traps.	S17	429	FTMN	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:07	0442244	6361130	8-Oct-18	12:26	-	-	Minnow Trap	5 traps deployed; 4.5 retrieved.	S3	437	LKCH	96	10	1	-	-	-	FR	-	N	-	-	N	L	2	
7-Oct-18	17:07	0442244	6361130	8-Oct-18	12:26	-	-	Minnow Trap	5 traps deployed; 4.5 retrieved	S3	447	FTMN	61	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:07	0442244	6361130	8-Oct-18	12:26	-	-	Minnow Trap	5 traps deployed; 4.5 retrieved	S3	447-2	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:07	0442244	6361130	8-Oct-18	12:26	-	-	Minnow Trap	5 traps deployed; 4.5 retrieved	S3	448	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
7-Oct-18	17:07	0442244	6361130	8-Oct-18	12:26	-	-	Minnow Trap	5 traps deployed; 4.5 retrieved	S3	449	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	8:53	0441953	6361194	8-Oct-18	10:45	0441932	6361135	Gillnet	Net of 8 pannels.	D41	433	ARGR	169	47	1	-	-	-	-	PIT	N	-	989001004739245	N	N	-	
8-Oct-18	8:53	0441953	6361194	8-Oct-18	10:45	0441932	6361135	Gillnet	Net of 8 pannels.	D41	434	ARGR	174	51	1	-	-	-	-	PIT	N	-	989001004080169	N	N	-	

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Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
8-Oct-18	8:53	0441953	6361194	8-Oct-18	10:45	0441932	6361135	Gillnet	Net of 8 pannels.	D41	435	ARGR	226	126	1	-	-	-	SC	PIT	N	-	989001004080440	N	N	2	Old wound on tail.
8-Oct-18	11:17	0442387	6360497	8-Oct-18	13:11	0442333	6360522	Gillnet	Net of 8 pannels.	I29	458	ARGR	180	60	1	-	-	-	-	PIT	N	-	989001004739146	N	N	-	
8-Oct-18	11:17	0442387	6360497	8-Oct-18	13:11	0442333	6360522	Gillnet	Net of 8 pannels.	I29	459	ARGR	227	145	1	-	-	-	SC	PIT	N	-	989001004739093	N	N	2	
8-Oct-18	11:17	0442387	6360497	8-Oct-18	13:11	0442333	6360522	Gillnet	Net of 8 pannels.	I29	460	WHSC	224	121	1	-	-	-	-	PIT	N	-	989001004739171	N	N	-	
8-Oct-18	11:17	0442387	6360497	8-Oct-18	13:11	0442333	6360522	Gillnet	Net of 8 pannels.	I29	461	LKCH	78	9	1	-	-	-	FR	-	N	-	-	N	N	1	
8-Oct-18	11:05	0442025	6361186	8-Oct-18	12:56	0442016	6361123	Gillnet	Net of 8 pannels	S18	436	WHSC	315	373	1	-	M	F	FR	-	N	-	-	Y	L	6	
8-Oct-18	11:05	0442025	6361186	8-Oct-18	12:56	0442016	6361123	Gillnet	Net of 8 pannels.	S18	462	WHSC	257	202	1	-	-	-	FR	PIT	N	-	989001004739128	N	N	6	
8-Oct-18	10:45	0441940	6360382	8-Oct-18	11:56	0441957	6360402	Gillnet	Net of 1 single pannel.	S26	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
8-Oct-18	9:25	0442248	6360411	8-Oct-18	11:10	0442213	6360447	Gillnet	Net of 8 pannels.	S29	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
8-Oct-18	11:46	0442092	6361183	8-Oct-18	13:40	0442092	6361165	Gillnet	Single panel.	S4	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
8-Oct-18	12:10	0442087	6360410	8-Oct-18	14:08	0442097	6360434	Gillnet	Net of 1 single pannel.	S9	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	472	WHSC	102	11	1	-	-	-	FR	-	N	-	-	N	L	1	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	473	TRPR	45	1	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	474	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	475	FTMN	67	4	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	476	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	477	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	478	WHSC	110	15	1	-	-	-	FR	-	N	-	-	N	N	1	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	479	WHSC	111	13	1	-	-	-	FR	-	N	-	-	N	N	1	
8-Oct-18	14:43	0441907	6361172	9-Oct-18	10:25	-	-	Minnow Trap	5 traps.	D41	480	LKCH	95	9	1	-	-	-	FR	-	N	-	-	N	L	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	481	LKCH	87	8	1	-	-	-	FR	-	N	-	-	N	N	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	482	WHSC	94	10	1	-	-	-	FR	-	N	-	-	N	L	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	483	WHSC	89	10	1	-	-	-	FR	-	N	-	-	Y	N	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	484	WHSC	91	10	1	-	-	-	-	-	N	-	-	Y	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	485	WHSC	99	12	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	486	TRPR	65	4	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	487	WHSC	100	13	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	488	WHSC	105	13	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	489	WHSC	103	11	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	490	LKCH	78	7	1	-	-	-	FR	-	N	-	-	N	N	ns	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	491	WHSC	103	13	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	492	WHSC	93	9	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	493	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	494	WHSC	88	8	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	495	LKCH	100	13	1	-	-	-	FR	-	N	-	-	N	N	2	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	496	WHSC	66	13	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	497	WHSC	98	10	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	498	WHSC	98	11	1	-	-	-	-	-	N	-	-	N	N		
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	499	WHSC	106	13	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	500	LKCH	102	13	1	-	-	-	FR	-	N	-	-	N	N	2	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	501	WHSC	88	13	1	-	-	-	FR	-	N	-	-	N	N	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	502	FTMN	64	3	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	503	WHSC	99	11	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	504	WHSC	114	15	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	505	FTMN	69	4	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	506	LKCH	120	18	1	-	-	-	FR	-	N	-	-	N	N	4	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	507	LKCH	102	12	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	508	LKCH	120	20	1	-	-	-	FR	-	N	-	-	N	N	4	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	509	TRPR	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	510	LKCH	99	12	1	-	-	-	FR	-	N	-	-	N	N	3	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	511	FTMN	68	4	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	512	WHSC	96	11	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	513	LKCH	114	18	1	-	-	-	FR	-	N	-	-	N	N	3	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	514	WHSC	89	10	1	-	-	-	FR	-	N	-	-	Y	N	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	515	LKCH	80	6	1	-	-	-	FR	-	N	-	-	N	N	2	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	516	LKCH	102	11	1	-	-	-	FR	-	N	-	-	N	N	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	517	LKCH	88	8	1	-	-	-	FR	-	N	-	-	N	N	1	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	518	LKCH	110	15	1	-	-	-	FR	-	N	-	-	N	N	2	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	519	LKCH	89	5	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:49	0441760	6361175	9-Oct-18	10:18	-	-	Minnow Trap	5 traps.	D43	520	FTMN	73	4	1	-	-	-	FR	-	N	-	-	N	N	2	
8-Oct-18	14:53	0441460	6360980	9-Oct-18	10:11	-	-	Minnow Trap	5 traps.	I21	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
8-Oct-18	14:59	441470	6360900	9-Oct-18	10:06	-	-	Minnow Trap	4 traps.	I7	465	FTMN	54	1	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:37	0442302	6361063	9-Oct-18	10:29	-	-	Minnow Trap	5 traps.	S14	466	TRPR	75	4	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:37	0442302	6361063	9-Oct-18	10:29	-	-	Minnow Trap	5 traps.	S14	467	FTMN	70	3	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:37	0442302	6361063	9-Oct-18	10:29	-	-	Minnow Trap	5 traps.	S14	468	TRPR	70	4	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:37	0442302	6361063	9-Oct-18	10:29	-	-	Minnow Trap	5 traps.	S14	469	FTMN	49	1	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:37	0442302	6361063	9-Oct-18	10:29	-	-	Minnow Trap	5 traps.	S14	470	FTMN	61	2	1	-	-	-	-	-	N	-	-	N	N	-	
8-Oct-18	14:37	0442302	6361063	9-Oct-18	10:29	-	-	Minnow Trap	5 traps.	S14	471	LKCH	121	21	1	-	-	-	FR	-	N	-	-	N	L	3	
8-Oct-18	14:31	0442397	6361029	9-Oct-18	10:33	-	-	Minnow Trap	5 traps.	S16	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	533	LKCH	114	15	1	-	-	-	-	-	N	-	-	N	N	-	Top of caudal fin missing.
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	534	LKCH	83	6	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	535	FTMN	52	1	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	536	TRPR	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	537	WHSC	131	29	1	-	-	-	FR	PIT	N	-	989001004739144	N	N	2	Most of caudal fin missing.
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	538	LKCH	84	7	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	539	LKCH	104	14	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	540	LKCH	91	11	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	541	LKCH	141	33	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	542	LKCH	102	12	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	543	LKCH	125	23	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	544	LKCH	80	7	1	-	-	-	-	-	N	-	-	Y	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	545	LKCH	122	22	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	546	LKCH	80	6	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	547	LKCH	80	6	1	-	-	-	-	-	N	-	-	N	N		
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	548	LKCH	92	9	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	549	LKCH	118	18	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	550	LKCH	134	30	1	-	-	-	-	-	N	-	-	Y	N	-	Swollen soft belly. May just be fat.
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	551	LKCH	99	11	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	552	LKCH	110	15	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	553	LKCH	89	8	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	554	LKCH	79	6	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	556	LKCH	113	16	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	557	LKCH	113	17	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	558	LKCH	81	6	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	559	LKCH	85	7	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	560	LKCH	86	8	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	561	LKCH	87	6	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	562	LKCH	88	7	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	563	LKCH	116	17	1	-	-	-	-	-	N	-	-	N	N		
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	564	LKCH	89	8	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	565	LKCH	93	8	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	566	LKCH	70	5	1	-	-	-	-	-	N	-	-	Y	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	567	LKCH	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	568	LKCH	83	6	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	569	LKCH	81	6	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	570	LKCH	89	8	1	-	-	-	-	-	N	-	-	Y	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	571	LKCH	75	5	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	572	LKCH	85	6	1	-	-	-	-	-	N	-	-	N	N		
9-Oct-18	13:31	0442624	6360662	10-Oct-18	9:56	-	-	Minnow Trap	5 traps.	S11	573	LKCH	90	10	1	-	-	-	-	-	N	-	-	N	N	-	

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Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
9-Oct-18	13:01	442679	6360796	10-Oct-18	10:01	-	-	Minnow Trap	5 traps.	S13	521	FTMN	57	1	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:10	0442020	6361182	10-Oct-18	10:31	-	-	Minnow Trap	5 traps.	S18	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
9-Oct-18	12:52	0442471	6361044	10-Oct-18	10:17	-	-	Minnow Trap	5 traps.	S28	574	LKCH	89	9	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	12:52	0442471	6361044	10-Oct-18	10:17	-	-	Minnow Trap	5 traps.	S28	575	LKCH	98	9	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	12:52	0442471	6361044	10-Oct-18	10:17	-	-	Minnow Trap	5 traps.	S28	576	LKCH	86	9	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:17	0442212	6360407	10-Oct-18	10:09	-	-	Minnow Trap	5 traps.	S29	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	522	TRPR	77	4	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	523	TRPR	68	3	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	524	TRPR	78	4	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	525	LKCH	94	11	1	-	-	-	-	-	N	-	-	Y	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	526	LKCH	88	7	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	527	LKCH	80	7	1	-	-	-	-	-	N	-	-	Y	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	528	LKCH	94	9	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	529	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	530	FTMN	60	2	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	531	LKCH	89	8	1	-	-	-	-	-	N	-	-	N	N	-	
9-Oct-18	13:35	0442556	6360599	10-Oct-18	9:50	-	-	Minnow Trap	5 traps.	S6	532	TRPR	72	4	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:54	0442429	6361055	11-Oct-18	11:30	-	-	Minnow Trap	5 traps.	S15	599	BRST	62	2	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:54	0442429	6361055	11-Oct-18	11:30	-	-	Minnow Trap	5 traps.	S15	600	BRST	57	1	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:54	0442429	6361055	11-Oct-18	11:30	-	-	Minnow Trap	5 traps.	S15	601	TRPR	74	5	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:54	0442429	6361055	11-Oct-18	11:30	-	-	Minnow Trap	5 traps.	S15	602	TRPR	84	6	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:06	0442360	6361170	11-Oct-18	11:05	-	-	Minnow Trap	5 traps.	S19	577	LKCH	123	24	1	-	-	-	-	-	N	-	-	Y	N	-	
10-Oct-18	11:06	0442360	6361170	11-Oct-18	11:05	-	-	Minnow Trap	5 traps.	S19	578	FTMN	65	3	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:06	0442360	6361170	11-Oct-18	11:05	-	-	Minnow Trap	5 traps.	S19	579	LKCH	84	8	1	-	-	-	-	-	N	-	-	Y	N	-	
10-Oct-18	11:06	0442360	6361170	11-Oct-18	11:05	-	-	Minnow Trap	5 traps.	S19	580	FTMN	63	3	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:02	0442419	6361135	11-Oct-18	11:45	-	-	Minnow Trap	5 traps.	S21	603	LKCH	85	9	1	-	-	-	-	-	N	-	-	Y	N	-	Torn caudal fin.
10-Oct-18	11:02	0442419	6361135	11-Oct-18	11:45	-	-	Minnow Trap	5 traps.	S21	604	BRST	56	2	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:02	0442419	6361135	11-Oct-18	11:45	-	-	Minnow Trap	5 traps.	S21	605	FTMN	59	2	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:02	0442419	6361135	11-Oct-18	11:45	-	-	Minnow Trap	5 traps.	S21	606	BRST	55	1	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:27	0441253	6361394	11-Oct-18	11:35	-	-	Minnow Trap	5 traps.	S22	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	589	LKCH	107	17	1	-	-	-	-	-	N	-	-	Y	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	590	LKCH	90	8	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	591	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	592	LKCH	59	3	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	593	LKCH	99	13	1	-	-	-	-	-	N	-	-	Y	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	594	LKCH	119	19	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	595	LKCH	86	8	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	596	FTMN	62	3	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	597	LKCH	78	7	1	-	-	-	-	-	N	-	-	Y	N	-	
10-Oct-18	11:24	0441259	6361425	11-Oct-18	11:00	-	-	Minnow Trap	5 traps.	S24	598	TRPR	76	5	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.11 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps.	S27	581	FTMN	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps.	S27	582	LKCH	129	27	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps.	S27	583	LKCH	91	9	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps.	S27	584	LKCH	89	9	1	-	-	-	-	-	N	-	-	Y	N	-	
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps.	S27	585	LKCH	92	11	1	-	-	-	-	-	N	-	-	Y	N	-	
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps.	S27	586	LKCH	69	5	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps.	S27	587	FTMN	57	2	1	-	-	-	-	-	N	-	-	N	N	-	
10-Oct-18	10:45	0441950	6360442	11-Oct-18	11:10	-	-	Minnow Trap	5 traps	S27	588	LKCH	91	9	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.12 Fish captured during the fall fishing program at Calumet Lake and Calumet River, September 2018.

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
02-Oct-18	15:25	454257	6363874	03-Oct-18	15:25	-	-	Minnow Trap	1 trap	MT73	1	FNDC	66	3.3	1	-	-	-	-	-	N	-	-	N	N	-	
02-Oct-18	15:25	454257	6363874	03-Oct-18	15:25	-	-	Minnow Trap	1 trap	MT73	2	FNDC	67	3.2	1	-	-	-	-	-	N	-	-	N	N	-	
02-Oct-18	15:25	454257	6363874	03-Oct-18	15:25	-	-	Minnow Trap	1 trap	MT73	3	FNDC	66	3.5	1	-	-	-	-	-	N	-	-	N	N	-	
02-Oct-18	15:25	454257	6363874	03-Oct-18	15:25	-	-	Minnow Trap	1 trap	MT73	4	FNDC	57	2.2	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	1	NRPK	133	14.7	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	2	LKCH	32	0.51	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	3	LKCH	48	1.33	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	4	LKCH	38	0.56	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	5	LKCH	35	0.52	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	6	LKCH	40	0.85	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	7	LKCH	45	1.04	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	8	LKCH	56	1.94	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	9	LKCH	48	1.28	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	10	LKCH	49	1.56	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	11	LKCH	48	1.3	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	12	LKCH	30	0.35	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	13	LKCH	30	0.43	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	14	LKCH	31	0.37	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	15	LKCH	29	0.28	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	16	LKCH	36	0.62	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	17	BRST	43	0.87	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	18	WHSC	36	0.58	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	19	WHSC	37	0.66	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	20	WHSC	43	1.18	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	21	WHSC	36	0.56	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	22	LNSC	30	0.3	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	23	LNSC	50	1.52	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	24	LNSC	47	1.28	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	25	LNSC	48	1.26	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	26	LNSC	46	1.23	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	27	LNSC	37	0.64	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.12 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	28	BRST	41	0.65	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	11:35	460757	6363185	2-Oct-18	12:12	460622	6363154	Backpack E-fishing	865 sec; 139 m	EF-1	29	LKCH	33	0.42	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	30	LKCH	39	0.52	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	31	LKCH	32	0.47	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	32	LKCH	37	0.73	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	33	LKCH	48	1.26	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #1
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	34	LKCH	44	0.93	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	35	LKCH	36	0.6	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	36	LKCH	35	0.75	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	37	LKCH	30	0.34	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	38	LKCH	27	0.26	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	39	LKCH	30	0.32	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	40	LKCH	48	0.6	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	41	LKCH	50	1.32	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #2
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	42	LKCH	45	0.32	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	43	LKCH	37	0.68	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	44	LKCH	34	0.45	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	45	LKCH	34	0.4	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	46	LKCH	36	0.55	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	47	LKCH	38	0.56	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	48	LKCH	30	0.33	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	49	LKCH	48	1.38	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #3
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	50	LKCH	25	0.22	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	51	LKCH	25	0.2	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec, 199 m	EF-2	52	LKCH	33	0.33	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	53	LKCH	32	0.32	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	54	LKCH	45	0.94	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #4
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	55	LKCH	34	0.38	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	56	LKCH	36	0.46	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	57	LKCH	36	0.59	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec, 199 m	EF-2	58	LKCH	28	0.4	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.12 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	59	LKCH	59	2.1	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	60	LKCH	32	0.4	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	61	LKCH	21	0.18	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	62	LKCH	36	0.48	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	63	LKCH	35	0.59	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	64	LKCH	27	0.28	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	65	LKCH	32	0.33	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	66	LKCH	35	0.41	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	67	LKCH	36	0.59	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec, 199 m	EF-2	68	LKCH	47	1.14	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #5
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	69	LKCH	46	1.03	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #6
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	70	FNDC	28	0.26	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	71	FNDC	28	0.23	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	72	FNDC	26	0.16	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec, 199 m	EF-2	73	FNDC	25	0.14	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	74	FNDC	24	0.23	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	75	FNDC	30	0.37	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	76	FNDC	29	0.33	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	77	FNDC	30	0.42	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	78	FNDC	26	0.19	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	79	FNDC	24	0.16	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	80	FNDC	20	0.11	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	81	FNDC	26	0.2	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	82	FNDC	27	0.22	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	83	FNDC	23	0.14	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	84	FNDC	23	0.17	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	85	FNDC	22	0.15	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	86	FNDC	27	0.18	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	87	FNDC	24	0.16	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	88	FNDC	22	0.19	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	89	LKCH	50	1.31	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #7

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Table A4.12 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	90	LKCH	32	0.42	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	91	LKCH	40	0.78	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	92	LKCH	35	0.5	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	93	LKCH	34	0.44	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	94	LKCH	25	0.12	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	95	LKCH	35	0.4	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	96	LKCH	37	0.62	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	97	LKCH	34	0.46	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	98	LKCH	30	0.27	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	99	LKCH	34	0.41	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	100	LKCH	32	0.35	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	101	LKCH	31	0.37	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	102	LKCH	25	0.26	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	103	LKCH	32	0.45	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	104	LKCH	31	0.33	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	105	LKCH	30	0.35	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	106	LKCH	38	0.33	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	107	LKCH	36	0.22	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	108	LKCH	35	0.58	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	109	LKCH	48	1.09	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #8
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	110	LKCH	40	0.74	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	111	LKCH	29	0.31	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	112	LKCH	34	0.52	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	113	LKCH	33	0.46	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	114	LKCH	32	0.31	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	115	LKCH	25	0.23	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	116	LKCH	30	0.28	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	117	LKCH	38	0.62	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	118	LKCH	46	1.17	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #9
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	119	LKCH	44	0.98	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #10
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	120	LKCH	39	0.74	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.12 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	121	LKCH	35	0.48	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	122	BRST	45	0.78	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	123	FNDC	35	0.53	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	124	FNDC	20	0.17	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	125	FNDC	24	0.17	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	126	FNDC	42	0.8	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	127	FNDC	28	0.27	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	128	FNDC	24	0.16	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	129	FNDC	29	0.3	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	130	FNDC	25	0.11	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	131	FNDC	22	0.1	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	132	FNDC	26	0.24	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	133	FNDC	25	0.14	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	134	FNDC	26	0.22	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	135	FNDC	24	0.26	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	136	WHSC	34	0.48	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	12:12	460622	6363154	2-Oct-18	13:37	460442	6363069	Backpack E-fishing	406 sec; 199 m	EF-2	137	WHSC	44	0.89	1	-	-	-	-	-	N	-	-	N	L	-	Voucher #1
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	138	LKCH	70	4.3	1	-	-	-	FR	-	N	-	-	N	L	2	Voucher #11
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	139	LKCH	79	6.24	1	-	-	-	FR	-	N	-	-	N	L	2	Voucher #12
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	140	LKCH	70	4.42	1	-	-	-	FR	-	N	-	-	N	L	2	Voucher #13
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	141	LKCH	63	2.86	1	-	-	-	FR	-	N	-	-	N	L	1	Voucher #14
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	142	WHSC	92	9.12	1	-	-	-	FR	-	N	-	-	N	L	1	Voucher #2
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	143	WHSC	105	14.61	1	-	-	-	FR	-	N	-	-	N	L	1	Voucher #3
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	144	WHSC	195	102.77	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	145	WHSC	177	74	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	146	WHSC	117	20.18	1	-	-	-	FR	-	N	-	-	N	L	2	Voucher #4
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	147	WHSC	112	18.87	1	-	-	-	FR	-	N	-	-	N	L	2	Voucher #5
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	148	WHSC	129	28.45	1	-	-	-	FR	-	N	-	-	N	N	2	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	149	WHSC	114	18.22	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	150	WHSC	117	21.2	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	151	WHSC	60	2.97	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.12 (Cont'd.)

Start Date	Start Time	Start UTM E	Start UTM N	End Date	End Time	End UTM E	End UTM N	Gear	Gear Settings	Station ID	Fish ID	Species	Fork Length (mm)	Weight (g)	Count	Stage code	Maturity code	Sex	Ageing Structure Collected? (FR/OT/SC)	Tag Type	Recap (Y/N)	Previous Tag#	Tag#	Potential Parasite?	Tissue Sample (L/NL/N)	Age	Comments
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	152	WHSC	67	3.8	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	153	WHSC	65	3.52	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	154	LKCH	59	2.25	1	-	-	-	FR	-	N	-	-	N	L	1	Voucher #15
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	155	LKCH	47	1.29	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	156	LKCH	39	0.69	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	157	LKCH	51	1.5	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	158	BRST	50	1.09	1	-	-	-	-	-	N	-	-	N	N	-	
2-Oct-18	15:00	460442	6363069	2-Oct-18	15:37	460198	6363041	Backpack E-fishing	930 sec; 246 m	EF-3	159	BRST	48	1.1	1	-	-	-	-	-	N	-	-	N	N	-	

Table A4.13 Concentrations of metals in fish tissue samples collected from Horizon Lake and Calumet River, October 2018.

		Horizon Lake												Calumet River	
		200-250 mm WHSC (n=3)			251-300 mm WHSC (n=3)			301-350mm WHSC (n=2)			FTMN	LKCH	WHSC	LKCH	WHSC
Variable	Units	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Composite	Composite	Composite	Composite	Composite
Fish Length	mm	215	227.3333	246	251	262.3333	281	309	312	315	60-70	90-120	80-100	90-120	80-100
Total Metals															
Aluminum (Al)-Total	mg/kg wwt	<0.4	0.443333	0.53	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	***29.4***	**10.7**	***32***	**3.67**	**10.7**
Antimony (Sb)-Total	mg/kg wwt	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Arsenic (As)-Total	mg/kg wwt	0.0201	0.036333	0.0483	0.021	0.023433	0.0268	0.0196	0.0222	0.0248	0.139	0.0358	0.158	0.0241	0.0439
Barium (Ba)-Total	mg/kg wwt	0.091	0.135	0.205	0.064	0.106333	0.163	0.062	0.0675	0.073	4.42	1.03	1.74	1.29	1.39
Beryllium (Be)-Total	mg/kg wwt	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bismuth (Bi)-Total	mg/kg wwt	<0.002	0.002433	0.0033	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron (B)-Total	mg/kg wwt	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cadmium (Cd)-Total	mg/kg wwt	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0077	0.0076	0.0049	0.0057	0.0045
Calcium (Ca)-Total	mg/kg wwt	404	533	617	272	425.3333	721	204	263	322	7540	7700	6240	7180	8020
Cesium (Cs)-Total	mg/kg wwt	0.0034	0.004267	0.0051	0.0031	0.004	0.0047	0.0036	0.00375	0.0039	0.0076	0.0045	0.0077	0.0026	0.0032
Chromium (Cr)-Total	mg/kg wwt	0.08	0.109333	0.13	0.049	0.051	0.055	0.056	0.0615	0.067	0.532	0.546	0.805	0.225	0.745
Cobalt (Co)-Total	mg/kg wwt	<0.004	0.004767	0.0057	<0.004	0.0041	0.0043	<0.004	0.00475	0.0055	0.0283	0.023	0.0851	0.0137	0.0322
Copper (Cu)-Total	mg/kg wwt	0.21	0.22	0.238	0.226	0.272667	0.319	0.303	0.3575	0.412	***0.756***	***0.886***	***1.34***	***0.729***	***0.961***
Iron (Fe)-Total	mg/kg wwt	4.4	4.666667	5.17	3.93	4.996667	6.41	5.55	6.065	6.58	67.1	34.5	76.6	34.9	71.8
Lead (Pb)-Total	mg/kg wwt	<0.004	0.023067	0.0427	<0.004	0.0042	0.0046	<0.004	<0.004	<0.004	0.0308	0.44	0.0338	0.0155	0.0087
Lithium (Li)-Total	mg/kg wwt	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Magnesium (Mg)-Total	mg/kg wwt	255	266.3333	275	252	270.3333	281	272	273.5	275	321	417	709	333	373
Manganese (Mn)-Total	mg/kg wwt	0.37	0.694333	0.916	0.266	0.471667	0.782	0.206	0.2145	0.223	4.77	5.4	7.72	4.78	9.52
Mercury (Hg)-Total	mg/kg wwt	0.093	0.110	0.122	0.080	0.115	0.165	0.120	0.138	0.156	0.0411	0.0685	0.0317		0.0325
Molybdenum (Mo)-Total	mg/kg wwt	0.007	0.007867	0.0084	0.0052	0.005833	0.0065	0.0075	0.0081	0.0087	0.0608	0.064	0.0643	0.0348	0.0709
Nickel (Ni)-Total	mg/kg wwt	0.048	0.052	0.06	<0.04	<0.04	<0.04	<0.04	0.0415	0.043	0.363	0.373	0.532	0.149	0.463
Phosphorus (P)-Total	mg/kg wwt	2350	2416.667	2510	2230	2366.667	2550	2350	2405	2460	5730	6090	5210	5890	6220
Potassium (K)-Total	mg/kg wwt	3900	4123.333	4240	4030	4170	4240	4180	4290	4400	2640	2930	2870	2970	3220
Rubidium (Rb)-Total	mg/kg wwt	1.48	1.756667	2.08	1.42	1.546667	1.7	1.47	1.625	1.78	1.78	1.41	1.75	1.59	1.11
Selenium (Se)-Total	mg/kg wwt	0.198	0.262	**0.314**	0.26	**0.281667**	**0.304**	**0.303**	**0.3145**	**0.328**	**0.542**	**0.51**	**0.48**	**0.441**	0.232
Silver (Ag)-Total	mg/kg wwt	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0017	**0.0034**	**0.0067**	0.0012	**0.0047**
Sodium (Na)-Total	mg/kg wwt	250	275	297	256	270.6667	285	278	288.5	299	875	865	875	804	893
Strontium (Sr)-Total	mg/kg wwt	0.319	0.406333	0.456	0.19	0.348	0.634	0.133	0.176	0.219	8.86	8.12	6.16	10.7	10.4
Sulfur (S)-Total	mg/kg wwt														
Tellurium (Te)-Total	mg/kg wwt	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Thallium (Tl)-Total	mg/kg wwt	<0.0004	0.001243	0.00228	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.00481	0.00143	0.00322	0.00096	0.00099
Thorium (Th)-Total	mg/kg wwt	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.0088	<0.006	0.0106	<0.006	<0.006
Tin (Sn)-Total	mg/kg wwt	<0.02	0.021	0.023	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.026	<0.02	<0.02	<0.02
Titanium (Ti)-Total	mg/kg wwt	0.035	0.038	0.04	0.031	0.033333	0.036	0.024	0.0315	0.039	0.475	0.21	0.485	0.092	0.189
Uranium (U)-Total	mg/kg wwt	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.0044	0.00144	0.00472	0.001	0.0013
Vanadium (V)-Total	mg/kg wwt	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.121	0.042	0.123	<0.02	0.048
Zinc (Zn)-Total	mg/kg wwt	3.66	4.37	4.92	3.57	4.003333	4.35	3.53	3.965	4.4	32.9	28.2	23.8	31.8	16.6
Zirconium (Zr)-Total	mg/kg wwt	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.042	<0.04	0.045	<0.04	<0.04
Tainting Compounds															
Toluene	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Orange shaded value = exceedances of National USEPA and/or Region III USEPA criteria used for evaluating potential risk of fish consumption to human health (Table 2.9)
Threshold values were derived from effects data for fish muscle tissue presented in Jarvinen and Ankley (1999) and used in the JOSMP tissue program (JOSMP 2015). Additional information is presented in Table 2.10.
Bold value = exceeds lethal lowest no-effects threshold
Underline value = exceeds sublethal lowest no-effects threshold
Italics value = exceeds lethal lowest effects threshold
Grey shaded value = exceeds sublethal lowest effects threshold

001587

Table A4.14 Concentrations of organic compounds in fish tissue samples collected from Horizon Lake and Calumet River, October 2018.

		Horizon Lake												Calumet River	
		200-250 mm WHSC (n=2)			251-300 mm WHSC (n=3)			301-350 mm WHSC (n=2)			FTMN	LKCH	WHSC	LKCH	WHSC
Variable	Units	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Composite	Composite	Composite	Composite	Composite
Fish length	mm	221	233.5	246	251	262.3333	281	309	312	315	60-70	90-120	80-100	90-120	80-100
% Moisture	%	81.7	82.3	82.9	81.8	81.9	82	80.3	80.65	81	79.9	77	79.6	77	79.2
1,1,1,2-Tetrachloroethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1-Trichloroethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2,2-Tetrachloroethane	mg/kg wwt	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2-Trichloroethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-Dichloropropene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3-Trichlorobenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3-Trichloropropane	mg/kg wwt	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01
1,2,4-Trichlorobenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,4-Trimethylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
1,2-Dibromo-3-chloropropane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-Dibromoethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	0.010	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-Dichloroethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-Dichloropropane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3,5-Trimethylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichloropropane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,2-Dichloropropane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-Chlorotoluene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4-Chlorotoluene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromobenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromochloromethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromoform	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromomethane	mg/kg wwt	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carbon tetrachloride	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroethane	mg/kg wwt	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloroform	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloromethane	mg/kg wwt	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,2-Dichloroethene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
cis-1,3-Dichloropropene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibromochloromethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	0.010333	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibromomethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorodifluoromethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	0.010333	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobutadiene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Isopropylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
m+p-Xylenes	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene chloride	mg/kg wwt	0.06764	0.14674	0.22584	0.20264	0.25884	0.36945	0.27662	0.32031	0.364	0.01195	0.30422	0.26859	0.18533	0.03458
n-Butylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-Propylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	0.012333	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p-Isopropyltoluene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
sec-Butylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Styrene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
tert-Butylbenzene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
Tetrachloroethene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thiophene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
trans-1,2-Dichloroethene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
trans-1,3-Dichloropropene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichloroethene	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichlorofluoromethane	mg/kg wwt	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vinyl chloride	mg/kg wwt	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

ALS

Hatfield Consultants
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North Vancouver BC V7P 0A3

Date Received: 16-OCT-18
Report Date: 19-NOV-18 16:08 (MT)
Version: FINAL

Client Phone: 604-926-3621

Certificate of Analysis

Lab Work Order #: L2181663
Project P.O. #: CNRL9078
Job Reference:
C of C Numbers:
Legal Site Desc:

Dana Brown, Chem. Tech. DIPL
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-1 CALUMET RIVER WHSC COMPOSITE							
Sampled By: MI on 02-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	79.2	DLIS	1.3	%		25-OCT-18	R4300467
% Moisture	79.2		0.50	%		06-NOV-18	R4300467
Silver (Ag)-Total	0.0047		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.189		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	10.7		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0439		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	1.39		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	0.0045		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	8020		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0032		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.745		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0322		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.961		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	71.8		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.0087		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	373		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	9.52		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0709		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.463		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	6220		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	3220		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.11		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.232		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	893		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	10.4		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	0.00099		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	0.00130		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	0.048		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	16.6		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.03458		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-1 CALUMET RIVER WHSC COMPOSITE							
Sampled By: MI on 02-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.010		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-1 CALUMET RIVER WHSC COMPOSITE							
Sampled By: MI on 02-OCT-18							
Matrix: Tissue							
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-2 CALUMET RIVER LKCH COMPOSITE							
Sampled By: MI on 02-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	77.0		0.50	%		06-NOV-18	R4300467
% Moisture	77.0	DLIS	1.3	%		25-OCT-18	R4300467
Silver (Ag)-Total	0.0012		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.092		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	3.67		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0241		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	1.29		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	0.0057		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	7180		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0026		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.225		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0137		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.729		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	34.9		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.0155		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	333		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	4.78		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0348		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.149		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	5890		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	2970		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.59		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.441		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	804		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	10.7		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	0.00096		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	0.00100		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	31.8		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-2 CALUMET RIVER LKCH COMPOSITE							
Sampled By: MI on 02-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.18533		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-2 CALUMET RIVER LKCH COMPOSITE							
Sampled By: MI on 02-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	70.7		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	71.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-3 HOIRZON LAKE FTMN COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	79.9		0.50	%		06-NOV-18	R4300467
% Moisture	79.9	DLIS	1.3	%		25-OCT-18	R4300467
Silver (Ag)-Total	0.0017		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	0.0088		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.475		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	29.4		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.139		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	4.42		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	0.0077		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	7540		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0076		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.532		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0283		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.756		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	67.1		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.0308		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	321		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	4.77		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0608		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.363		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	5730		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	2640		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.78		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.542		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	875		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	8.86		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	0.00481		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-3 HOIRZON LAKE FTMN COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Uranium (U)-Total	0.00440		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	0.121		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	32.9		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	0.042		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.01195		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-3 HOIRZON LAKE FTMN COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-4 HOIRZON LAKE WHSC COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	79.6		0.50	%		06-NOV-18	R4300467
% Moisture	79.6	DLIS	1.3	%		25-OCT-18	R4300467
Silver (Ag)-Total	0.0067		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	0.0106		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.485		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	32.0		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.158		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	1.74		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	0.0049		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	6240		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0077		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.805		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0851		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	1.34		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	76.6		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.0338		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	709		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	7.72		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0643		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.532		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	5210		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-4 HOIRZON LAKE WHSC COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Potassium (K)-Total	2870		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.75		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.460		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	875		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	6.16		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	0.00322		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	0.00472		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	0.123		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	23.8		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	0.045		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.26859		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-4 HOIRZON LAKE WHSC COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.10		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.10		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.01		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	71.9		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	72.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-5 HOIRZON LAKE LKCH COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	77.0	DLIS	1.3	%		25-OCT-18	R4300467
% Moisture	77.0		0.50	%		06-NOV-18	R4300467
Silver (Ag)-Total	0.0034		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.210		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	10.7		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0358		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	1.03		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	0.0076		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	7700		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0045		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.546		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0230		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.866		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-5 HOIRZON LAKE LKCH COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Iron (Fe)-Total	34.5		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.440		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	417		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	5.40		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0640		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.373		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	6090		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	2930		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.41		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.510		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	865		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	8.12		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	0.00143		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	0.026		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	0.00144		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	0.042		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	28.2		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.30422		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

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Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-5 HOIRZON LAKE LKCH COMPOSITE							
Sampled By: MI on 12-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	70.3		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	N/A	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	70.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-6 WHSC-27							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	81.7	DLIS	1.3	%		25-OCT-18	R4300467
% Moisture	81.7		0.50	%		06-NOV-18	R4300467
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.039		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0201		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.091		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-6 WHSC-27							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Bismuth (Bi)-Total	0.0033		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	404		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0034		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.118		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.210		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	4.40		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	269		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.370		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0070		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.048		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2350		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	4240		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.48		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.314		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	250		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.319		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	3.66		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.06764		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-6 WHSC-27							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	70.5		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	72.8		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	71.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	73.0		70-130	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-7 WHSC-28							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.040		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-7 WHSC-28							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0483		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.109		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	617		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0051		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.130		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0046		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.212		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	4.43		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.0427		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	255		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.797		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0082		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.060		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2390		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	3900		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	2.08		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.198		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	278		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.456		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	0.00228		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	0.023		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	4.53		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
L2181663-8 WHSC-33							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	82.9		0.50	%		06-NOV-18	R4300467
% Moisture	82.9		0.25	%		07-NOV-18	R4324851
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.035		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	0.53		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0406		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.205		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-8 WHSC-33							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Calcium (Ca)-Total	578		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0043		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.080		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0057		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.238		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	5.17		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.0225		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	275		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.916		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0084		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.048		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2510		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	4230		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.71		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.274		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	297		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.444		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	0.00105		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	4.92		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Methylene chloride	0.22584		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-8 WHSC-33							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichloropropane	<0.02		0.020	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-9 WHSC-37							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	82.0		0.50	%		06-NOV-18	R4300467
% Moisture	82.0	DLIS	1.3	%		25-OCT-18	R4300467
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.033		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-9 WHSC-37							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0268		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.163		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	721		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0047		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.049		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0043		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.273		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	4.65		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	281		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.782		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0065		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2550		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	4240		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.42		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.304		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	285		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.634		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	4.35		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.20264		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-9 WHSC-37							
Sampled By: MI on 04-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	0.011		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	0.011		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	0.011		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	0.017		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	72.1		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	77.0		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	72.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	77.0		70-130	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-10 WHSC-175							
Sampled By: MI on 05-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	81.8		0.50	%		06-NOV-18	R4300467
% Moisture	81.8	DLIS	1.3	%		25-OCT-18	R4300467
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.031		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0210		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.064		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	272		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0031		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.055		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.226		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	6.41		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	278		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.266		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0052		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2320		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	4240		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.52		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.281		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	256		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.190		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	3.57		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.20443		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-10 WHSC-175							
Sampled By: MI on 05-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	71.4		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	74.6		70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-10 WHSC-175							
Sampled By: MI on 05-OCT-18							
Matrix: Tissue							
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	71.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	75.0		70-130	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-11 WHSC-176							
Sampled By: MI on 05-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	81.9	DLIS	1.3	%		25-OCT-18	R4300467
% Moisture	81.9		0.50	%		06-NOV-18	R4300467
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.036		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0225		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.092		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	283		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0042		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.049		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.319		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	3.93		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	0.0046		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	252		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.367		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0058		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2230		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	4030		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.70		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.260		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	271		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.220		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	4.09		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-11 WHSC-176							
Sampled By: MI on 05-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Methylene chloride	0.36945		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-11 WHSC-176							
Sampled By: MI on 05-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	05-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	05-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-12 WHSC-351							
Sampled By: MI on 06-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	80.3		0.25	%		07-NOV-18	R4324851
% Moisture	80.3		0.50	%		06-NOV-18	R4300467
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.024		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0196		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.062		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	204		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0036		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.067		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0055		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.412		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	6.58		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	275		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.206		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0087		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	0.043		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2350		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	4180		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.47		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.303		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	278		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.133		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-12 WHSC-351							
Sampled By: MI on 06-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	3.53		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Methylene chloride	0.3640		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-12 WHSC-351							
Sampled By: MI on 06-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: Toluene d8	n/a	SOL:MI	-	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-13 WHSC-436							
Sampled By: MI on 08-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	81.0		0.50	%		06-NOV-18	R4300467
% Moisture	81.0		0.25	%		07-NOV-18	R4324851
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.039		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0248		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.073		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	322		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0039		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.056		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.303		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Iron (Fe)-Total	5.55		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	272		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.223		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0075		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2460		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-13 WHSC-436							
Sampled By: MI on 08-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Potassium (K)-Total	4400		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.78		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.326		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	299		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.219		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	4.40		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Methylene chloride	0.27662		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-13 WHSC-436							
Sampled By: MI on 08-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	70.2		70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	72.6		70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	70.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	73.0		70-130	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190
L2181663-14 WHSC-DUP							
Sampled By: MI on 06-OCT-18							
Matrix: Tissue							
Miscellaneous Parameters							
% Moisture	81.6		0.25	%		07-NOV-18	R4324851
% Moisture	81.6		0.50	%		06-NOV-18	R4300467
Silver (Ag)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thorium (Th)-Total	<0.0060		0.0060	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Titanium (Ti)-Total	0.033		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Metals in Tissue by CRC ICPMS (WET)							
Aluminum (Al)-Total	<0.40		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Antimony (Sb)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Arsenic (As)-Total	0.0158		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Barium (Ba)-Total	0.063		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Beryllium (Be)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Bismuth (Bi)-Total	<0.0020		0.0020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Boron (B)-Total	<0.20		0.20	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cadmium (Cd)-Total	<0.0010		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Calcium (Ca)-Total	242		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cesium (Cs)-Total	0.0037		0.0010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Chromium (Cr)-Total	0.061		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Cobalt (Co)-Total	0.0050		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Copper (Cu)-Total	0.377		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-14 WHSC-DUP							
Sampled By: MI on 06-OCT-18							
Matrix: Tissue							
Metals in Tissue by CRC ICPMS (WET)							
Iron (Fe)-Total	6.02		0.60	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lead (Pb)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Lithium (Li)-Total	<0.10		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Magnesium (Mg)-Total	278		0.40	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Manganese (Mn)-Total	0.226		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Molybdenum (Mo)-Total	0.0074		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Nickel (Ni)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Phosphorus (P)-Total	2360		2.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Potassium (K)-Total	4130		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Rubidium (Rb)-Total	1.49		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Selenium (Se)-Total	0.303		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Sodium (Na)-Total	274		4.0	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Strontium (Sr)-Total	0.165		0.010	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tellurium (Te)-Total	<0.0040		0.0040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Thallium (Tl)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Tin (Sn)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Uranium (U)-Total	<0.00040		0.00040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Vanadium (V)-Total	<0.020		0.020	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zinc (Zn)-Total	3.34		0.10	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
Zirconium (Zr)-Total	<0.040		0.040	mg/kg wwt	16-NOV-18	18-NOV-18	R4343549
EPA 8260 Volatile Organic Compounds							
Dichlorodifluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloromethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Vinyl chloride	<0.20		0.20	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromomethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroethane	<0.10		0.10	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichlorofluoromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Methylene chloride	0.35741		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,2-Dichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chloroform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Carbon tetrachloride	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Benzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Trichloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromodichloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromomethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
cis-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
trans-1,3-Dichloropropene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Toluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2-Trichloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Tetrachloroethene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Dibromochloromethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2181663-14 WHSC-DUP							
Sampled By: MI on 06-OCT-18							
Matrix: Tissue							
EPA 8260 Volatile Organic Compounds							
1,2-Dibromoethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Chlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Ethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,1,2-Tetrachloroethane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
m+p-Xylenes	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
o-Xylene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Styrene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromoform	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Isopropylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,1,2,2-Tetrachloroethane	<0.050		0.050	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichloropropane	<0.020		0.020	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Propylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Bromobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3,5-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
2-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
4-Chlorotoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
tert-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trimethylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
sec-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
p-Isopropyltoluene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,3-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,4-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
n-Butylbenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2-Dibromo-3-chloropropane	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,4-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Hexachlorobutadiene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
1,2,3-Trichlorobenzene	<0.010		0.010	mg/kg wwt	01-NOV-18	06-NOV-18	R4318190
Surrogate: 1,4-Difluorobenzene (SS)	73.9		70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene (SS)	71.4		70-130	%	01-NOV-18	06-NOV-18	R4318190
Surrogate: 3,4-Dichlorotoluene (SS)	n/a	SOL:MI	70-130	%	01-NOV-18	06-NOV-18	R4318190
Thiophene by EPA 8260							
Thiophene	<0.010		0.010	mg/kg wwt		05-NOV-18	R4318190
Surrogate: 1,2-Dichloroethane d4	74.0		70-130	%		05-NOV-18	R4318190
Surrogate: Toluene d8	71.0		70-130	%		05-NOV-18	R4318190
Surrogate: 4-Bromofluorobenzene	n/a	SOL:MI	-	%		05-NOV-18	R4318190

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLIS	Detection Limit Adjusted: Insufficient Sample
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
SOL:MI	Surrogate recovery outside acceptable limits due to matrix interference

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-CCMS-N-VA	Tissue	Silver in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

ALS Test Code	Matrix	Test Description	Method Reference**
MET-WET-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

ALS Test Code	Matrix	Test Description	Method Reference**
PREP-MOISTURE-ED	Soil	% Moisture	Oven dry 105C-Gravimetric

The weighed portion of soil is placed in a 105 C oven to dry to a constant weight; the drying time will vary based on the moisture content of the soil. The dried soil weight is then used to calculate % moisture.

Reference: ASTM D2974-00.

ALS Test Code	Matrix	Test Description	Method Reference**
PREP-MOISTURE-ED	Tissue	% Moisture	Oven dry 105C-Gravimetric
TH-WET-CCMS-N-VA	Tissue	Th in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered

ALS Test Code	Matrix	Test Description	Method Reference**
THIOPHENE-ED	Soil	Thiophene by EPA 8260	SW 846 8260-GC-MS

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

ALS Test Code	Matrix	Test Description	Method Reference**
TI-WET-CCMS-N-VA	Tissue	Ti in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered

ALS Test Code	Matrix	Test Description	Method Reference**
VOC-MEOH-8260-ED	Soil	EPA 8260 Volatile Organic Compounds	EPA 8260C/5021A

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Quality Control Report

Client: Hatfield Consultants
200 - 850 Harbourside Drive
North Vancouver BC V7P 0A3

Contact: Meghan Isaacs, Dan Moats

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PREP-MOISTURE-ED	Soil							
Batch R4300467								
WG2914285-3 DUP		**L2181663-1**						
% Moisture		79.2	78.9		%	0.4	20	25-OCT-18
WG2914285-2 LCS								
% Moisture			96.8		%		90-110	25-OCT-18
WG2914285-1 MB								
% Moisture			<0.25		%		0.25	25-OCT-18
THIOPHENE-ED	Soil							
Batch R4318190								
WG2914150-3 DUP		**L2181663-1**						
Thiophene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	50	05-NOV-18
WG2914150-2 LCS								
Thiophene			95.0		%		60-140	05-NOV-18
WG2914150-1 MB								
Thiophene			<0.010		mg/kg		0.01	05-NOV-18
Surrogate: 1,2-Dichloroethane d4			85.0		%		70-130	05-NOV-18
Surrogate: Toluene d8			94.0		%		70-130	05-NOV-18
Surrogate: 4-Bromofluorobenzene			92.0		%		70-130	05-NOV-18
WG2914150-4 MS		**L2181663-14**						
Thiophene			98.0		%		50-150	05-NOV-18
VOC-MEOH-8260-ED	Soil							
Batch R4318190								
WG2914150-3 DUP		**L2181663-1**						
Dichlorodifluoromethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Chloromethane		<0.10	<0.10	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Vinyl chloride		<0.20	<0.20	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Bromomethane		<0.10	<0.10	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Chloroethane		<0.10	<0.10	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Trichlorofluoromethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,1-Dichloroethene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Methylene chloride		0.03458	0.01696		mg/kg wwt	6.1	30	05-NOV-18
trans-1,2-Dichloroethene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,1-Dichloroethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
2,2-Dichloropropane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
cis-1,2-Dichloroethene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Chloroform		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Bromochloromethane		<0.010	<0.010		mg/kg wwt	<0.010	0.02	05-NOV-18

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-MEOH-8260-ED	Soil							
Batch R4318190								
WG2914150-3 DUP		**L2181663-1**						
1,2-Dichloroethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,1,1-Trichloroethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,1-Dichloropropene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Carbon tetrachloride		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Benzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Trichloroethene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2-Dichloropropane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Bromodichloromethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Dibromomethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
cis-1,3-Dichloropropene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
trans-1,3-Dichloropropene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Toluene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,1,2-Trichloroethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,3-Dichloropropane		<0.010	<0.10	J	mg/kg wwt	0.004	0.02	05-NOV-18
Tetrachloroethene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Dibromochloromethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2-Dibromoethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Chlorobenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Ethylbenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,1,1,2-Tetrachloroethane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
m+p-Xylenes		<0.010	<0.010		mg/kg wwt	9.9	30	05-NOV-18
o-Xylene		<0.010	<0.010		mg/kg wwt	26	30	05-NOV-18
Styrene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Bromoform		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Isopropylbenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,1,2,2-Tetrachloroethane		<0.050	<0.050	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2,3-Trichloropropane		<0.010	<0.020	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
n-Propylbenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
Bromobenzene		<0.010	<0.010	J	mg/kg wwt	0.007	0.02	05-NOV-18
1,3,5-Trimethylbenzene		<0.010	<0.010		mg/kg wwt	23	30	05-NOV-18
2-Chlorotoluene		<0.010	<0.010		mg/kg wwt	n/a	0.02	05-NOV-18
4-Chlorotoluene		<0.010	<0.010		mg/kg wwt	24	30	05-NOV-18
tert-Butylbenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2,4-Trimethylbenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-MEOH-8260-ED	Soil							
Batch R4318190								
WG2914150-3 DUP		**L2181663-1**						
sec-Butylbenzene		<0.010	<0.010		mg/kg wwt	28	30	05-NOV-18
p-Isopropyltoluene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,3-Dichlorobenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,4-Dichlorobenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	n/a	0.02	05-NOV-18
n-Butylbenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2-Dichlorobenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2-Dibromo-3-chloropropane		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2,4-Trichlorobenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	n/a	0.02	05-NOV-18
Hexachlorobutadiene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
1,2,3-Trichlorobenzene		<0.010	<0.010	RPD-NA	mg/kg wwt	N/A	30	05-NOV-18
WG2914150-2 LCS								
Dichlorodifluoromethane			72.5		%		70-130	05-NOV-18
Chloromethane			91.6		%		70-130	05-NOV-18
Vinyl chloride			84.1		%		70-130	05-NOV-18
Bromomethane			120.6		%		70-130	05-NOV-18
Chloroethane			74.4		%		70-130	05-NOV-18
Trichlorofluoromethane			81.8		%		70-130	05-NOV-18
1,1-Dichloroethene			72.1		%		70-130	05-NOV-18
Methylene chloride			87.0		%		70-130	05-NOV-18
trans-1,2-Dichloroethene			76.1		%		70-130	05-NOV-18
1,1-Dichloroethane			89.9		%		70-130	05-NOV-18
2,2-Dichloropropane			77.0		%		70-130	05-NOV-18
cis-1,2-Dichloroethene			87.8		%		70-130	05-NOV-18
Chloroform			90.9		%		70-130	05-NOV-18
Bromochloromethane			119.3		%		70-130	05-NOV-18
1,2-Dichloroethane			102.5		%		70-130	05-NOV-18
1,1,1-Trichloroethane			81.0		%		70-130	05-NOV-18
1,1-Dichloropropene			78.4		%		70-130	05-NOV-18
Carbon tetrachloride			87.5		%		70-130	05-NOV-18
Benzene			90.6		%		70-130	05-NOV-18
Trichloroethene			99.6		%		70-130	05-NOV-18
1,2-Dichloropropane			90.6		%		70-130	05-NOV-18
Bromodichloromethane			82.9		%		70-130	05-NOV-18
Dibromomethane			109.0		%		70-130	05-NOV-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-MEOH-8260-ED	Soil							
Batch R4318190								
WG2914150-2 LCS								
cis-1,3-Dichloropropene			78.7		%		70-130	05-NOV-18
trans-1,3-Dichloropropene			75.7		%		70-130	05-NOV-18
Toluene			84.5		%		70-130	05-NOV-18
1,1,2-Trichloroethane			82.3		%		70-130	05-NOV-18
1,3-Dichloropropane			83.3		%		70-130	05-NOV-18
Tetrachloroethene			93.6		%		70-130	05-NOV-18
Dibromochloromethane			93.5		%		70-130	05-NOV-18
1,2-Dibromoethane			85.1		%		70-130	05-NOV-18
Chlorobenzene			89.1		%		70-130	05-NOV-18
Ethylbenzene			82.2		%		70-130	05-NOV-18
1,1,1,2-Tetrachloroethane			95.0		%		70-130	05-NOV-18
m+p-Xylenes			85.6		%		70-130	05-NOV-18
o-Xylene			84.0		%		70-130	05-NOV-18
Styrene			82.9		%		70-130	05-NOV-18
Bromoform			99.5		%		70-130	05-NOV-18
Isopropylbenzene			81.1		%		70-130	05-NOV-18
1,1,2,2-Tetrachloroethane			88.9		%		70-130	05-NOV-18
1,2,3-Trichloropropane			104.6		%		70-130	05-NOV-18
n-Propylbenzene			82.1		%		70-130	05-NOV-18
Bromobenzene			98.7		%		70-130	05-NOV-18
1,3,5-Trimethylbenzene			90.0		%		70-130	05-NOV-18
2-Chlorotoluene			93.8		%		70-130	05-NOV-18
4-Chlorotoluene			92.3		%		70-130	05-NOV-18
tert-Butylbenzene			88.8		%		70-130	05-NOV-18
1,2,4-Trimethylbenzene			92.8		%		70-130	05-NOV-18
sec-Butylbenzene			92.0		%		70-130	05-NOV-18
p-Isopropyltoluene			83.1		%		70-130	05-NOV-18
1,3-Dichlorobenzene			92.3		%		70-130	05-NOV-18
1,4-Dichlorobenzene			96.4		%		70-130	05-NOV-18
n-Butylbenzene			84.9		%		70-130	05-NOV-18
1,2-Dichlorobenzene			94.6		%		70-130	05-NOV-18
1,2-Dibromo-3-chloropropane			88.4		%		70-130	05-NOV-18
1,2,4-Trichlorobenzene			113.1		%		70-130	05-NOV-18
Hexachlorobutadiene			100.7		%		70-130	05-NOV-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-MEOH-8260-ED	Soil							
Batch R4318190								
WG2914150-2 LCS								
1,2,3-Trichlorobenzene			108.1		%		70-130	05-NOV-18
WG2914150-1 MB								
Dichlorodifluoromethane			<0.010		mg/kg		0.01	05-NOV-18
Chloromethane			<0.10		mg/kg		0.1	05-NOV-18
Vinyl chloride			<0.20		mg/kg		0.2	05-NOV-18
Bromomethane			<0.10		mg/kg		0.1	05-NOV-18
Chloroethane			<0.10		mg/kg		0.1	05-NOV-18
Trichlorofluoromethane			<0.010		mg/kg		0.01	05-NOV-18
1,1-Dichloroethene			<0.010		mg/kg		0.01	05-NOV-18
Methylene chloride			<0.010		mg/kg		0.01	05-NOV-18
trans-1,2-Dichloroethene			<0.010		mg/kg		0.01	05-NOV-18
1,1-Dichloroethane			<0.010		mg/kg		0.01	05-NOV-18
2,2-Dichloropropane			<0.010		mg/kg		0.01	05-NOV-18
cis-1,2-Dichloroethene			<0.010		mg/kg		0.01	05-NOV-18
Chloroform			<0.010		mg/kg		0.01	05-NOV-18
Bromochloromethane			<0.010		mg/kg		0.01	05-NOV-18
1,2-Dichloroethane			<0.010		mg/kg		0.01	05-NOV-18
1,1,1-Trichloroethane			<0.010		mg/kg		0.01	05-NOV-18
1,1-Dichloropropene			<0.010		mg/kg		0.01	05-NOV-18
Carbon tetrachloride			<0.010		mg/kg		0.01	05-NOV-18
Benzene			<0.010		mg/kg		0.01	05-NOV-18
Trichloroethene			<0.010		mg/kg		0.01	05-NOV-18
1,2-Dichloropropane			<0.010		mg/kg		0.01	05-NOV-18
Bromodichloromethane			<0.010		mg/kg		0.01	05-NOV-18
Dibromomethane			<0.010		mg/kg		0.01	05-NOV-18
cis-1,3-Dichloropropene			<0.010		mg/kg		0.01	05-NOV-18
trans-1,3-Dichloropropene			<0.010		mg/kg		0.01	05-NOV-18
Toluene			<0.010		mg/kg		0.01	05-NOV-18
1,1,2-Trichloroethane			<0.010		mg/kg		0.01	05-NOV-18
1,3-Dichloropropane			<0.010		mg/kg		0.01	05-NOV-18
Tetrachloroethene			<0.010		mg/kg		0.01	05-NOV-18
Dibromochloromethane			<0.010		mg/kg		0.01	05-NOV-18
1,2-Dibromoethane			<0.010		mg/kg		0.01	05-NOV-18
Chlorobenzene			<0.010		mg/kg		0.01	05-NOV-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-MEOH-8260-ED	Soil							
Batch **R4318190**								
WG2914150-1 **MB**								
Ethylbenzene			<0.010		mg/kg		0.01	05-NOV-18
1,1,1,2-Tetrachloroethane			<0.010		mg/kg		0.01	05-NOV-18
m+p-Xylenes			<0.010		mg/kg		0.01	05-NOV-18
o-Xylene			<0.010		mg/kg		0.01	05-NOV-18
Styrene			<0.010		mg/kg		0.01	05-NOV-18
Bromoform			<0.010		mg/kg		0.01	05-NOV-18
Isopropylbenzene			<0.010		mg/kg		0.01	05-NOV-18
1,1,2,2-Tetrachloroethane			<0.050		mg/kg		0.05	05-NOV-18
1,2,3-Trichloropropane			<0.020		mg/kg		0.02	05-NOV-18
n-Propylbenzene			<0.010		mg/kg		0.01	05-NOV-18
Bromobenzene			<0.010		mg/kg		0.01	05-NOV-18
1,3,5-Trimethylbenzene			<0.010		mg/kg		0.01	05-NOV-18
2-Chlorotoluene			<0.010		mg/kg		0.01	05-NOV-18
4-Chlorotoluene			<0.010		mg/kg		0.01	05-NOV-18
tert-Butylbenzene			<0.010		mg/kg		0.01	05-NOV-18
1,2,4-Trimethylbenzene			<0.010		mg/kg		0.01	05-NOV-18
sec-Butylbenzene			<0.010		mg/kg		0.01	05-NOV-18
p-Isopropyltoluene			<0.010		mg/kg		0.01	05-NOV-18
1,3-Dichlorobenzene			<0.010		mg/kg		0.01	05-NOV-18
1,4-Dichlorobenzene			<0.010		mg/kg		0.01	05-NOV-18
n-Butylbenzene			<0.010		mg/kg		0.01	05-NOV-18
1,2-Dichlorobenzene			<0.010		mg/kg		0.01	05-NOV-18
1,2-Dibromo-3-chloropropane			<0.010		mg/kg		0.01	05-NOV-18
1,2,4-Trichlorobenzene			<0.010		mg/kg		0.01	05-NOV-18
Hexachlorobutadiene			<0.010		mg/kg		0.01	05-NOV-18
1,2,3-Trichlorobenzene			<0.010		mg/kg		0.01	05-NOV-18
Surrogate: 1,4-Difluorobenzene (SS)			84.6		%		70-130	05-NOV-18
Surrogate: 4-Bromofluorobenzene (SS)			93.8		%		70-130	05-NOV-18
Surrogate: 3,4-Dichlorotoluene (SS)			92.3		%		70-130	05-NOV-18
AG-WET-CCMS-N-VA	Tissue							
Batch **R4343549**								
WG2932293-3 **CRM**		**VA-NRC-DORM4**						
Silver (Ag)-Total			110.5		%		70-130	18-NOV-18
WG2932293-2 **DUP**		**L2181663-1**						

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
AG-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-2 DUP		**L2181663-1**						
Silver (Ag)-Total		0.0047	0.0048		mg/kg wwt	2.9	40	18-NOV-18
WG2932293-4 LCS								
Silver (Ag)-Total			93.8		%		70-130	18-NOV-18
WG2932293-1 MB								
Silver (Ag)-Total			<0.0010		mg/kg wwt		0.001	18-NOV-18
MET-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-3 CRM		**VA-NRC-DORM4**						
Aluminum (Al)-Total			103.9		%		70-130	18-NOV-18
Arsenic (As)-Total			101.3		%		70-130	18-NOV-18
Barium (Ba)-Total			106.2		%		70-130	18-NOV-18
Beryllium (Be)-Total			0.0205		mg/kg wwt		0.005-0.025	18-NOV-18
Bismuth (Bi)-Total			0.0107		mg/kg wwt		0.002-0.022	18-NOV-18
Boron (B)-Total			100.5		%		70-130	18-NOV-18
Cadmium (Cd)-Total			105.4		%		70-130	18-NOV-18
Calcium (Ca)-Total			105.7		%		70-130	18-NOV-18
Cesium (Cs)-Total			101.3		%		70-130	18-NOV-18
Chromium (Cr)-Total			108.5		%		70-130	18-NOV-18
Cobalt (Co)-Total			106.0		%		70-130	18-NOV-18
Copper (Cu)-Total			100.1		%		70-130	18-NOV-18
Iron (Fe)-Total			109.5		%		70-130	18-NOV-18
Lead (Pb)-Total			105.8		%		70-130	18-NOV-18
Lithium (Li)-Total			1.19		mg/kg wwt		0.71-1.71	18-NOV-18
Magnesium (Mg)-Total			106.0		%		70-130	18-NOV-18
Manganese (Mn)-Total			98.2		%		70-130	18-NOV-18
Molybdenum (Mo)-Total			96.8		%		70-130	18-NOV-18
Nickel (Ni)-Total			98.2		%		70-130	18-NOV-18
Phosphorus (P)-Total			101.0		%		70-130	18-NOV-18
Potassium (K)-Total			105.8		%		70-130	18-NOV-18
Rubidium (Rb)-Total			107.4		%		70-130	18-NOV-18
Selenium (Se)-Total			108.1		%		70-130	18-NOV-18
Sodium (Na)-Total			105.0		%		70-130	18-NOV-18
Strontium (Sr)-Total			93.3		%		70-130	18-NOV-18
Thallium (Tl)-Total			102.7		%		70-130	18-NOV-18
Uranium (U)-Total			102.7		%		70-130	18-NOV-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-3 CRM		**VA-NRC-DORM4**						
Vanadium (V)-Total			98.4		%		70-130	18-NOV-18
Zinc (Zn)-Total			108.4		%		70-130	18-NOV-18
Zirconium (Zr)-Total			0.258		mg/kg wwt		0.054-0.454	18-NOV-18
WG2932293-2 DUP		**L2181663-1**						
Aluminum (Al)-Total		10.7	10.1		mg/kg wwt	5.7	40	18-NOV-18
Antimony (Sb)-Total		<0.0020	<0.0020	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
Arsenic (As)-Total		0.0439	0.0454		mg/kg wwt	3.4	40	18-NOV-18
Barium (Ba)-Total		1.39	1.42		mg/kg wwt	2.7	40	18-NOV-18
Beryllium (Be)-Total		<0.0020	<0.0020	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
Bismuth (Bi)-Total		<0.0020	<0.0020	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
Boron (B)-Total		<0.20	<0.20	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
Cadmium (Cd)-Total		0.0045	0.0045		mg/kg wwt	0.8	40	18-NOV-18
Calcium (Ca)-Total		8020	8070		mg/kg wwt	0.7	60	18-NOV-18
Cesium (Cs)-Total		0.0032	0.0031		mg/kg wwt	1.3	40	18-NOV-18
Chromium (Cr)-Total		0.745	0.671		mg/kg wwt	11	40	18-NOV-18
Cobalt (Co)-Total		0.0322	0.0319		mg/kg wwt	0.7	40	18-NOV-18
Copper (Cu)-Total		0.961	0.965		mg/kg wwt	0.4	40	18-NOV-18
Iron (Fe)-Total		71.8	79.2		mg/kg wwt	9.8	40	18-NOV-18
Lead (Pb)-Total		0.0087	0.0099		mg/kg wwt	12	40	18-NOV-18
Lithium (Li)-Total		<0.10	<0.10	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
Magnesium (Mg)-Total		373	378		mg/kg wwt	1.5	40	18-NOV-18
Manganese (Mn)-Total		9.52	9.81		mg/kg wwt	3.1	40	18-NOV-18
Molybdenum (Mo)-Total		0.0709	0.0669		mg/kg wwt	5.9	40	18-NOV-18
Nickel (Ni)-Total		0.463	0.396		mg/kg wwt	16	40	18-NOV-18
Phosphorus (P)-Total		6220	6270		mg/kg wwt	0.7	40	18-NOV-18
Potassium (K)-Total		3220	3240		mg/kg wwt	0.6	40	18-NOV-18
Rubidium (Rb)-Total		1.11	1.12		mg/kg wwt	1.4	40	18-NOV-18
Selenium (Se)-Total		0.232	0.244		mg/kg wwt	5.0	40	18-NOV-18
Sodium (Na)-Total		893	917		mg/kg wwt	2.6	40	18-NOV-18
Strontium (Sr)-Total		10.4	10.5		mg/kg wwt	0.9	60	18-NOV-18
Tellurium (Te)-Total		<0.0040	<0.0040	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
Thallium (Tl)-Total		0.00099	0.00093		mg/kg wwt	6.4	40	18-NOV-18
Tin (Sn)-Total		<0.020	<0.020	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
Uranium (U)-Total		0.00130	0.00145		mg/kg wwt	11	40	18-NOV-18

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-2 DUP		**L2181663-1**						
Vanadium (V)-Total		0.048	0.045		mg/kg wwt	5.7	40	18-NOV-18
Zinc (Zn)-Total		16.6	16.7		mg/kg wwt	0.8	40	18-NOV-18
Zirconium (Zr)-Total		<0.040	<0.040	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
WG2932293-4 LCS								
Aluminum (Al)-Total			101.5		%		70-130	18-NOV-18
Antimony (Sb)-Total			100.4		%		70-130	18-NOV-18
Arsenic (As)-Total			98.5		%		70-130	18-NOV-18
Barium (Ba)-Total			102.4		%		70-130	18-NOV-18
Beryllium (Be)-Total			103.7		%		70-130	18-NOV-18
Bismuth (Bi)-Total			100.1		%		70-130	18-NOV-18
Boron (B)-Total			100.6		%		70-130	18-NOV-18
Cadmium (Cd)-Total			98.1		%		70-130	18-NOV-18
Calcium (Ca)-Total			101.8		%		70-130	18-NOV-18
Cesium (Cs)-Total			100.3		%		70-130	18-NOV-18
Chromium (Cr)-Total			98.0		%		70-130	18-NOV-18
Cobalt (Co)-Total			97.1		%		70-130	18-NOV-18
Copper (Cu)-Total			95.9		%		70-130	18-NOV-18
Iron (Fe)-Total			97.1		%		70-130	18-NOV-18
Lead (Pb)-Total			99.0		%		70-130	18-NOV-18
Lithium (Li)-Total			103.5		%		70-130	18-NOV-18
Magnesium (Mg)-Total			109.4		%		70-130	18-NOV-18
Manganese (Mn)-Total			99.6		%		70-130	18-NOV-18
Molybdenum (Mo)-Total			103.0		%		70-130	18-NOV-18
Nickel (Ni)-Total			98.0		%		70-130	18-NOV-18
Phosphorus (P)-Total			110.7		%		70-130	18-NOV-18
Potassium (K)-Total			102.9		%		70-130	18-NOV-18
Rubidium (Rb)-Total			99.7		%		70-130	18-NOV-18
Selenium (Se)-Total			99.6		%		70-130	18-NOV-18
Sodium (Na)-Total			103.2		%		70-130	18-NOV-18
Strontium (Sr)-Total			101.3		%		70-130	18-NOV-18
Tellurium (Te)-Total			99.3		%		70-130	18-NOV-18
Thallium (Tl)-Total			97.0		%		70-130	18-NOV-18
Tin (Sn)-Total			95.8		%		70-130	18-NOV-18
Uranium (U)-Total			98.6		%		70-130	18-NOV-18

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-4 LCS								
Vanadium (V)-Total			101.4		%		70-130	18-NOV-18
Zinc (Zn)-Total			92.5		%		70-130	18-NOV-18
Zirconium (Zr)-Total			97.1		%		70-130	18-NOV-18
WG2932293-1 MB								
Aluminum (Al)-Total			<0.40		mg/kg wwt		0.4	18-NOV-18
Antimony (Sb)-Total			<0.0020		mg/kg wwt		0.002	18-NOV-18
Arsenic (As)-Total			<0.0040		mg/kg wwt		0.004	18-NOV-18
Barium (Ba)-Total			<0.010		mg/kg wwt		0.01	18-NOV-18
Beryllium (Be)-Total			<0.0020		mg/kg wwt		0.002	18-NOV-18
Bismuth (Bi)-Total			<0.0020		mg/kg wwt		0.002	18-NOV-18
Boron (B)-Total			<0.20		mg/kg wwt		0.2	18-NOV-18
Cadmium (Cd)-Total			<0.0010		mg/kg wwt		0.001	18-NOV-18
Calcium (Ca)-Total			<4.0		mg/kg wwt		4	18-NOV-18
Cesium (Cs)-Total			<0.0010		mg/kg wwt		0.001	18-NOV-18
Chromium (Cr)-Total			<0.010		mg/kg wwt		0.01	18-NOV-18
Cobalt (Co)-Total			<0.0040		mg/kg wwt		0.004	18-NOV-18
Copper (Cu)-Total			<0.020		mg/kg wwt		0.02	18-NOV-18
Iron (Fe)-Total			<0.60		mg/kg wwt		0.6	18-NOV-18
Lead (Pb)-Total			<0.0040		mg/kg wwt		0.004	18-NOV-18
Lithium (Li)-Total			<0.10		mg/kg wwt		0.1	18-NOV-18
Magnesium (Mg)-Total			<0.40		mg/kg wwt		0.4	18-NOV-18
Manganese (Mn)-Total			<0.010		mg/kg wwt		0.01	18-NOV-18
Molybdenum (Mo)-Total			<0.0040		mg/kg wwt		0.004	18-NOV-18
Nickel (Ni)-Total			<0.040		mg/kg wwt		0.04	18-NOV-18
Phosphorus (P)-Total			<2.0		mg/kg wwt		2	18-NOV-18
Potassium (K)-Total			<4.0		mg/kg wwt		4	18-NOV-18
Rubidium (Rb)-Total			<0.010		mg/kg wwt		0.01	18-NOV-18
Selenium (Se)-Total			<0.010		mg/kg wwt		0.01	18-NOV-18
Sodium (Na)-Total			<4.0		mg/kg wwt		4	18-NOV-18
Strontium (Sr)-Total			<0.010		mg/kg wwt		0.01	18-NOV-18
Tellurium (Te)-Total			<0.0040		mg/kg wwt		0.004	18-NOV-18
Thallium (Tl)-Total			<0.00040		mg/kg wwt		0.0004	18-NOV-18
Tin (Sn)-Total			<0.020		mg/kg wwt		0.02	18-NOV-18
Uranium (U)-Total			<0.00040		mg/kg wwt		0.0004	18-NOV-18

ALS Environmental

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-1 MB								
Vanadium (V)-Total			<0.020		mg/kg wwt		0.02	18-NOV-18
Zinc (Zn)-Total			<0.10		mg/kg wwt		0.1	18-NOV-18
Zirconium (Zr)-Total			<0.040		mg/kg wwt		0.04	18-NOV-18
PREP-MOISTURE-ED	Tissue							
Batch R4300467								
WG2914285-3 DUP		**L2181663-1**						
% Moisture		79.2	78.9		%	0.4	20	06-NOV-18
WG2914285-2 LCS								
% Moisture			96.8		%		90-110	06-NOV-18
WG2914285-1 MB								
% Moisture			<0.50		%		0.5	06-NOV-18
TH-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-3 CRM		**VA-NRC-DORM4**						
Thorium (Th)-Total			105.8		%		70-130	18-NOV-18
WG2932293-2 DUP		**L2181663-1**						
Thorium (Th)-Total		<0.0060	<0.0060	RPD-NA	mg/kg wwt	N/A	40	18-NOV-18
WG2932293-4 LCS								
Thorium (Th)-Total			98.5		%		70-130	18-NOV-18
WG2932293-1 MB								
Thorium (Th)-Total			<0.0060		mg/kg wwt		0.006	18-NOV-18
TI-WET-CCMS-N-VA	Tissue							
Batch R4343549								
WG2932293-3 CRM		**VA-NRC-DORM4**						
Titanium (Ti)-Total			134.1	MES	%		70-130	18-NOV-18
WG2932293-2 DUP		**L2181663-1**						
Titanium (Ti)-Total		0.189	0.203		mg/kg wwt	6.9	40	18-NOV-18
WG2932293-4 LCS								
Titanium (Ti)-Total			99.2		%		70-130	18-NOV-18
WG2932293-1 MB								
Titanium (Ti)-Total			<0.020		mg/kg wwt		0.02	18-NOV-18

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: L2181663-COFC

Report To	
Company:	Hatfield Consultants
Contact:	Meghan Isaacs, Dan Moats
Address:	200-850 Harbourside Drive, North Vancouver, BC V7P 0A3
Phone:	604-926-3261
Fax:	604-926-5389

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)

Quality Control (QC) Report with Report ☐ Yes ☐ No

☐ Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email or Fax [redacted]

Email

Email

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

- R ☑ Regular (Standard TAT if received by 3 pm - business days)
- P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Invoice To			
Same as Report To	☑ Yes	☐ No
Copy of Invoice with Report	☑ Yes	☐ No
Company:		
Contact:		

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1: same as report

Email 2

Project Information

ALS Quote #:	Q66299
Job #:	
PO / AFE:	CNRL9078
LSD:	

Oil and Gas Required Fields (client use)

Approver ID:		Cost Center:	
GL Account:		Routing Code:	
Activity Code:			
Location:			
ALS Contact:	Dana Brown	Sampler:	Meghan Isaacs

ALS Lab Work Order # (lab use only)

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	#Q66299 Metals	#Q66299 Organics	Notes	Number of Containers
	Calumet River WHSC Composite	2-Oct-18	N/A	Tissue	R	R	Composite	1
	Calumet River LKCH Composite	2-Oct-18	N/A	Tissue	R	R	Composite	1
	Horizon Lake FTMN Composite	12-Oct-18	N/A	Tissue	R	R	Composite	1
	Horizon Lake WHSC Composite	12-Oct-18	N/A	Tissue	R	R	Composite	1
	Horizon Lake LKCH Composite	12-Oct-18	N/A	Tissue	R	R	Composite	1
	WHSC-27	4-Oct-18	N/A	Tissue	R	R		1
	WHSC-28	4-Oct-18	N/A	Tissue	R	R		1
	WHSC-33	4-Oct-18	N/A	Tissue	R	R		1
	WHSC-37	4-Oct-18	N/A	Tissue	R	R		1
	WHSC-175	5-Oct-18	N/A	Tissue	R	R		1
	WHSC-176	5-Oct-18	N/A	Tissue	R	R		1
	WHSC-351	6-Oct-18	N/A	Tissue	R	R		1
	WHSC-436	8-Oct-18	N/A	Tissue	R	R		1
	WHSC-DUP	6-Oct-18	N/A	Tissue	R	R		1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☐ No

Are samples for human drinking water use? ☐ Yes ☐ No

Special Instructions / Specify Criteria to add on report (client Use)

For samples indicated, please composite tissue before analysis.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	
-14			

SHIPMENT RELEASE (client use)		
Released by: [redacted]	Date: 10 OCT 18	Time: 1210

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by: [redacted]	Date: 10 Oct 18	Time: 12 11

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1 If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

Methyl Mercury Results

Flett Research Ltd.
440 DeSalaberry Ave Winnipeg, MB R2L 0Y7
Fax/Phone (204) 667-2505
E-mail flett@flettresearch.ca Webpage http://www.flettresearch.ca

CLIENT: Hatfield Consultants - CNRL9078 - Horizon Lake 2018
#200-850 Harbourside Dr.
North Vancouver, BC V7P 0A3

Date Received: October 19 and 23, 2018
Sampling Date: October 2018

Matrix: Tissue(dry)
Transaction ID: 804
PO/Contract No.:
Date Analysed: November 15, 2018
Analyst(s): Xiang W

Analytical Method: M10220 Methyl Mercury in Tissue by Digestion, Aqueous Ethylation Purge & Trap, and CVAFS with an Automated System (Version 3)

Comments: Samples which were comprised of three or more small, whole bodied fish were freeze dried and ground prior to analysis
For samples WHSC-Comp and LKCH-Comp two jars of sample were combined to create a single composite for analysis

Detection Limit: 16 ng/g (ML) MDL=4 ng/g The MDL was determined based on 7 replicates of analytical blanks (98% confidence level) and a 20 mg dry sample size
For reporting purposes results will be flagged below the ML which is considered a practical quantitation limit

Estimated Uncertainty: The estimated uncertainty of this method has been determined to be ± 13%at a concentration level of 4470 ng/g (95% confidence)

Results authorized by Dr. Robert J. Flett, Chief Scientist

QUALITY DATA

Blanks	pg of MeHg in whole ethylation EPA vial	Gross Peak Area	Mean Ethylation Blank (ng/L)
Ethylation blank (H_2O+Reagent)	0.16	288	0.00
Mean Eth Blank (last 30 runs)	0.25		0.00

	Net pg MeHg in whole Ethylation EPA vial	Gross Peak Area	Equiv CH Hg Conc. - based on current batch mean weight (0.0265g) of dry sample ng/g (Biota)	
Method Blank 1	0.11	482	0.326	
Method Blank 2	-0.02	256	0.000	
Method Blank 3	0.07	160	0.000	
Mean Method Blank	0.01		0.109	

Standards	MeHg Standard Added to Ethylation EPA Vial (pg CH_3Hg)	Gross Peak Area	Net Corrected MeHg Std Calibration Factor (units / pg)	RSD of MeHg Standard
Mean Value			3108	2.6

Spike Recovery Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	Sample Identification	Sample Type	Gross Peak Area	% CH_3Hg Recovery Used for Calculations	Dry Sample Mass (g)	% Wt. Loss On Drying	Wet Sample Mass (g)	Net CH_3Hg as Hg (ng/g-Dry-Wt)	Net CH_3Hg as Hg (ng/g-Wet-Wt)	CH_3Hg Recovery (%)
	(FTMN Comp)	MS1	154411	100%	0.016	78.4	0.075	434	94	95.8
	(FTMN Comp)	MS1D	186071	100%	0.018	78.4	0.085	458	99	98.0
	(Calumet River WHSC Comp)	MS2	189073	100%	0.037	76.6	0.157	235	55	102.3
	(Calumet River WHSC Comp)	MS2D	195054	100%	0.040	76.6	0.173	220	52	98.1
	Mean of Recoveries									**98.5**
QC Samples	Dorm-4 ID1501 (355± 28 ng/g)		306422	100%	0.044	4.1	0.046			88.9
	Dorm-4 ID1501 (355± 28 ng/g)	**Repeat Aliquot**	306300	100%	0.044	4.1	0.046			88.9
	Mean of Dorm-4							316		**88.9**
Alternate Source Standard (A.S.S.)	A.S.S. - Alfa ID1302 (1000 ng/L)		97286	100%				1061	<- Net CH_3Hg as Hg (ng/L)	**106.1**

LAB ID	Sampling Details	Sample ID	Date Sampled	Sample Type	Gross Peak Area	% CH_3Hg Recovery Used for Calculations	Weighed Dry Sample Mass (g)	% Wt. Loss On Drying	Calculated Wet Sample Mass (g)	Net CH3Hg as Hg (ng/g) Dry Wt. [recovery corrected] As Analyzed	Net CH3Hg as Hg (ng/g) Wet Wt. [recovery corrected] As Calculated
91900		FTMN Comp	October 2018		97850	98.5	0.02229	78.4	0.10301	**199**	**43.1**
91901		WHSC Comp	October 2018		130171	98.5	0.05012	77.3	0.22079	**118**	**26.8**
91902		LKCH Comp	October 2018		167538	98.5	0.02844	77.4	0.12584	**269**	**60.8**
91916		Calumet River WHSC Comp	October 2018	DupA1	90588	98.5	0.04041	76.6	0.17283	**103**	**24.1**
91916		Calumet River WHSC Comp	October 2018	DupA2	75840	98.5	0.03035	76.6	0.12981	**114**	**26.7**
91903		WHSC-27	October 2018		147394	98.5	0.01623	81.7	0.08857	**413**	**75.8**
91904		WHSC-28	October 2018		206696	98.5	0.01625	83.0	0.09539	**579**	**98.6**
91905		WHSC-33	October 2018		269347	98.5	0.02062	82.8	0.11973	**598**	**103**
91906		WHSC-37	October 2018		201585	98.5	0.02385	82.1	0.13330	**385**	**68.9**
91907		WHSC-175	October 2018		259702	98.5	0.01568	82.1	0.08766	**759**	**136**
91908		WHSC-176	October 2018	DupB1	168652	98.5	0.01958	82.7	0.11324	**396**	**68.4**
91908		WHSC-176	October 2018	DupB2	179494	98.5	0.02099	82.7	0.12140	**393**	**67.9**
91909		WHSC-351	October 2018		318764	98.5	0.03383	81.7	0.18498	**436**	**79.7**
91910		WHSC-436	October 2018		331917	98.5	0.02464	81.8	0.13534	**621**	**113**
91911		WHSC-DUP	October 2018		254429	98.5	0.03431	82.4	0.19481	**340**	**59.9**

* : See Comments' section above for discussion

Q:\Clients A-L\Hatfield Consultants CNRL\2018(804)\Methyl mercury\MTBIOT111518XW1.xls

Dup : Duplicate - two subsamples of the same sample carried through the analytical procedure in an identical manner

This test report shall not be reproduced, except in full, without written approval of the laboratory.
Note: Results relate only to the items tested.

CALA

ISO/IEC 17025:2005 Accredited with the Canadian Association for Laboratory Accreditation

Total Mercury Results

Flett Research Ltd.
440 DeSalaberry Ave. Winnipeg, MB R2L 0Y7
Fax/Phone (204) 667-2505
E-mail flett@flettresearch.ca Webpage. http://www flettresearch.ca

CLIENT: Hatfield Consultants: CNRL9078 - Horizon Lake 2018
#200-850 Harbourside Dr.
North Vancouver, BC V7P 0A3

Matrix: Tissue (dry)
ransaction ID: 804
/Contract No.:
Date Received: October 19 and 23, 2018
Date Analysed: November 16, 2018
Sampling Date: October 2018
Analyst(s): Zonca B.

Analytical Method: Determination of Total Mercury in Solids using EPA Method 7473 for DMA-80 Total Mercury Analyser as performed by Flett Research Ltd (Version 3)

Comments: Samples which were comprised of three or more small, whole bodied fish were freeze dried and ground prior to analysis.

For samples WHSC-Comp and LKCH-Comp two jars of sample were combined to create a single composite for analysis

Detection Limit: 6 ng/g ML

MDL=2 ng/g based on 7 replicates of analytical blanks (98% confidence). This limit assumes 10 mg dry samples. Lower detection limits are possible if greater sample weights are used. For reporting purposes results will be flagged below the ML which is considered a practical quantitation limit

Estimated Uncertainty: Uncertainty has been estimated at ± 17 % (95 % confidence)at total mercury concentrations between 4 and 3000 ng/g This uncertainty increases to 32% for defatted hepatopancreas (TORT-2) due to the consistently higher recovery for this CRM

Results authorized by Dr. Robert J. Flett, Chief Scientist

QUALITY DATA

Method Blanks	1st Method Blank (ng)	0 0000						
	2nd Method Blank (ng)	0 0431						
Standards	First 15 ng STD	14 87						
	2nd 15 ng STD	14 56						
	3rd 15 ng STD	14 67						
	4th 15 ng STD	14 54						
	50 ng STD 1st	47 73						
	50 ng STD 2nd	49 20						
Sample Spike Recovery	**SAMPLE IDENTIFICATION**	Sample Type						**Hg Recovery (%)**
	LKCH Comp	Spike	36 22	0 02452				98 1
	LKCH Comp	Spike	37 04	0 02389				99 5
	Mean of spiked duplicates for LKCH Comp				RPD=	-3 4		97 8
	WHSC-175	Spike	58 70	0 01141				96 5
	WHSC-175	Spike	62 50	0 01319				100 8
	Mean of spiked duplicates for WHSC-175				RPD=	-4.4		98 7
	Calumet River WHSC Comp	Spike	12 90	0 02090				99 5
	Calumet River WHSC Comp	Spike	13 26	0 02088				103 2
	Mean of spiked duplicates for Calumet River WHSC Comp				RPD=	-3 6		101 4
	Mean of Spike Recoveries							99 3
	DORM- 4 (410 ng/g)		4 53	0 01140		414.5		101 1
	DORM- 4 (410 ng/g)		4 46	0 01183		393 3		95 9
	DORM- 4 (410 ng/g)		4 33	0 01124		402.0		98 1
QC Samples	**DORM- 4 (410 ng/g) Mean**				RSD=	2.6		98 4

LAB ID	Sampling Details	Sample ID	Date Sampled	Sample Type	Hg (ng)	Sample dry weight added to boat (g)	% wt. loss on drying	Net Total Hg conc. (ng/g dry wt.) [recovery corrected] As Analyzed	Net Total Hg conc. (ng/g wet wt.) [recovery corrected] As Calculated	
91900		FTMN Comp	October 2018		3 97	0 02105	78 4	**190**	**41.1**	
91901		WHSC Comp	October 2018	DupA1	3 2	0 02317	77 3	**139**	**31.6**	
91901		WHSC Comp	October 2018	DupA2	3 16	0 02279	77 3	**140**	**31.8**	
91902		LKCH Comp	October 2018		7 22	0 024	77 4	**303**	**68.5**	
91916		Calumet River WHSC Comp	October 2018	DupB1	2 8	0 02079	76 6	**136**	**31.8**	
91916		Calumet River WHSC Comp	October 2018	DupB2	3 21	0 02278	76 6	**142**	**33.2**	
91903		WHSC-27	October 2018		6 48	0 01285	81 7	**508**	**93.1**	
91904		WHSC-28	October 2018		8 51	0 01272	83 0	**674**	**115**	
91905		WHSC-33	October 2018		9 24	0.01315	82.8	**708**	**122**	
91906		WHSC-37	October 2018		7 08	0.01597	82.1	**447**	**80.0**	
91907		WHSC-175	October 2018		10 65	0 01162	82 1	**923**	**165**	
91908		WHSC-176	October 2018		6 79	0 0118	82.7	**579**	**100**	
91909		WHSC-351	October 2018	DupC1	8 7	0 01335	81 7	**656**	**120**	
91909		WHSC-351	October 2018	DupC2	8 03	0 01247	81 7	[illegible]	**119**	
91910		WHSC-436	October 2018		9 36	0 01101	81 8	**856**	**156**	
91911		WHSC-DUP	October 2018		9 44	0 01426	82 4	**667**	**117**	

* : See 'Comments' section above for discussion.

Q \Clients A-L\Hatfield Consultants - CNRL\2018(804)\Total Mercury\TMDSOL111618ZB1 xls

This test report shall not be reproduced, except in full, without written approval of the laboratory.
Note: Results relate only to the items tested

Dup : Duplicate - two subsamples of the same sample carried through the analytical procedure in an identical manner

CALA

ISO/IEC 17025:2005 Accredited with the Canadian Association for Laboratory Accreditation

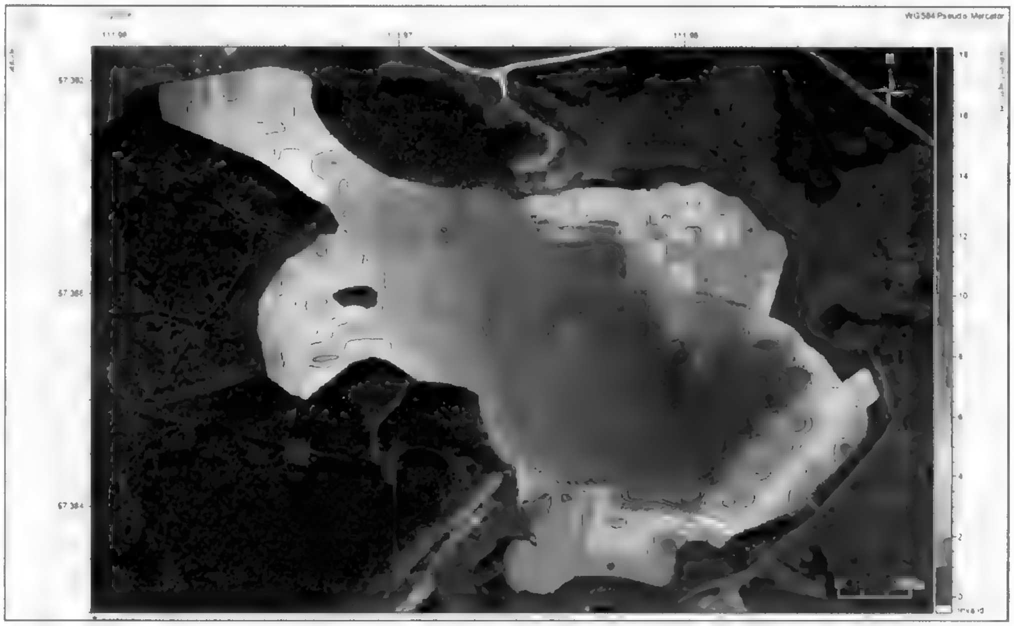
T00210-1 Version 082914

Appendix A5

Hydroacoustic Report

BioSonics®

FISH POPULATION ASSESSMENT REPORT: HORIZON LAKE, OCTOBER 9-11, 2018



December 28, 2018

Delivered to:

DAN MOATS
PROJECT MANAGER
HATFIELD CONSULTANTS
200-850 HARBOURSIDE DRIVE
NORTH VANCOUVER, BC V7P 0A3
CANADA

Table of Contents

List of Figures and Tables

Introduction

Horizon Lake is a 76.7 hectare compensation lake located approximately 60 km north of Fort McMurray, AB, Canada. Horizon Lake lies within the Tar River watershed adjacent to the Horizon Oil Sands Project. The purpose of this lake is to provide suitable habitat for establishing a self-sustaining population of resident fish species.

BioSonics was contracted by Hatfield Consultants for a third year to perform a hydroacoustic survey with the purpose of providing a fish population estimate for Horizon Lake. This information will be used in part to assess how well the compensation lake is performing with regards to nearby natural lakes.

Scientific split beam techniques have been shown to be effective in a wide variety of freshwater and marine environments. These techniques were chosen to meet the goals of this project. In this study, project goals were defined as:

- Performing a mobile survey of fish distribution and density in the lake
- Post processing the hydroacoustic data
- Estimating population of total fish in lake
- Size estimate of detected fish

A series of tactics was implemented to achieve specific goals, including:

- Planning survey transects and entering them into the navigational GPS
- Installation of a split beam hydroacoustic system onto a vessel of opportunity
- Acquiring hydroacoustic data along preplanned transects
- Post process data to meet the goals of the project

This report documents the findings from the hydroacoustic data collected during the mobile survey, including an estimate of fish numbers by species based on the catch data provided by concurrent fishing being conducted by Hatfield personnel.

Site Description

Location

Horizon Lake was surveyed two times in two nighttime surveys. The lake is located north of Fort McMurray, Alberta, Canada. The boat survey transects were driven parallel to each other and approximately 50 m apart. The total area of the lake is ~ 76.7 ha.

Latitude/Longitude of Site

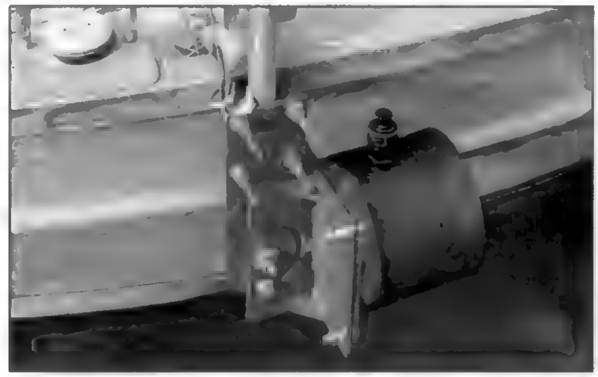
The geographic coordinates for the approximate center of Horizon Lake are 57.387013 N by 111.963616 W.

Hydroacoustic Instrument Installation

A 430 kHz split beam transducer was installed on the starboard side of the boat (Fig. 1, 2).

Figure 1. Transducer installed on boat

Figure 2. Close up of mount detail



The transducer was installed with the beam aimed straight down with the positive Y axis pointed towards the bow and the positive X axis pointed to the starboard side. The transducer face was placed at 0.2 meters below the surface – this shallow depth was chosen to maximize the amount of water beneath the transducer, allowing the boat to get closer to shore without damaging the transducer. The transducer cable connector was pointed aft to streamline the transducer profile as much as possible and reduce vibrations or potential cable damage.

The DT-X surface unit was connected to the transducer via the transducer cable – the cable was run inside the boat for ease of access to the surface unit. The Garmin DGPS antenna was mounted on top of the transducer pole, so the DT-X could collect geo-referenced hydroacoustic data suitable for mapping after post processing. The entire data collection system was powered from an AC generator supplied by Hatfield.

Hydroacoustic Observations

No night survey was conducted on 10/9 due to boat issues. Weather conditions on 10/10 were very calm and had excellent acoustic conditions (Fig.3). The conditions on the evening of 10/11 were slightly windy, resulting in a slight increase background noise, but still very good acoustically.

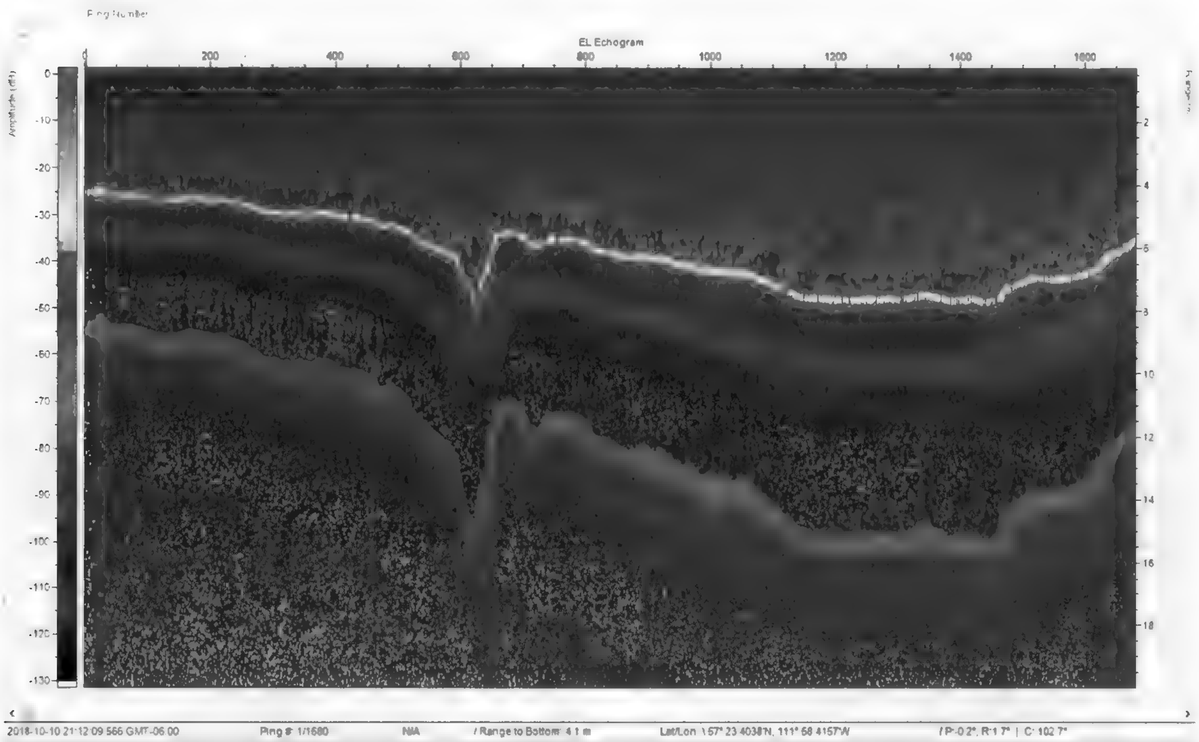


Figure 3. Echogram with clear acoustic conditions with very little surface noise

Hydroacoustic System

System, Components, Power

A 430 kHz BioSonics DT-X scientific echosounder with a split beam transducer was used on this project, supplied by BioSonics. The DT-X architecture digitizes the acoustic signal inside the transducer to eliminate effects of external electrical noise interference. Specific components included:

- DT-X Echosounder Surface Unit
- Transducer Cable, 25 feet in length
- Split Beam Transducer
- Panasonic Toughbook Laptop PC
- Hatfield supplied generator for powering electronics
- Visual Acquisition 6.x Data Acquisition and Playback Software
- Garmin 19X HVS DGPS

The Visual Acquisition 6 software package from BioSonics was operated on laptops running Microsoft Windows 7. The version number of this software was v6.3.1.10980. Data files were saved by this program to the hard drive on the laptop.

Data Collection and Analysis Parameters

The DT-X system was programmed to collect data with the following parameters:

(430 kHz)

- Hydroacoustic Data Collection Threshold: -130 dB (no thresholding)
- Pulse Repetition Rate: 10 Pings Per Second (pps)
- Collection Range: 0.3 – 20 m
- Power Level: 0.0 dB
- Pulse Duration: 0.3 ms
- Source Level: 219.3 dB||1 μPa
- Receive Sensitivity: -63.5 dB Counts/μPa
- -3 dB Beam Width: 6.8°

The hydroacoustic data was processed in Echoview using the following single echo parameters:

- TS Threshold: -65 dB
- Pulse length determination level: 6 dB
- Minimum normalized pulse length: 0.8
- Maximum normalized pulse length: 1.5
- Maximum beam compensation: 15 dB
- Max. Std. Dev. Minor axis angles: 0.600
- Max. Std. Dev. Major axis angles: 0.600

Summary of Data Analysis Methods and Results

Observations on data quality and appearance are reported for the DT-X system, and analytical products are reported for selected data segments from the survey areas showing the potential uses of both hydroacoustics in general, and BioSonics hardware and software specifically.

Figure 4. Cruise track and bathymetry map showing transects in Horizon Lake

There were 21 planned transects for Horizon Lake spaced approximately 50 m apart (Fig. 4). Lower water levels that exposed more of the underlying boulders and other underwater hazards made driving straight transects challenging at times, but the driver from Hatfield Consultants did an excellent job. A total of two night surveys were planned. The first night survey was completed on 10/10, and then the last night survey on 10/11. The primary focus of these transects was to collect data on a representative sample of the fish in the lake to estimate the fish population of Horizon Lake.

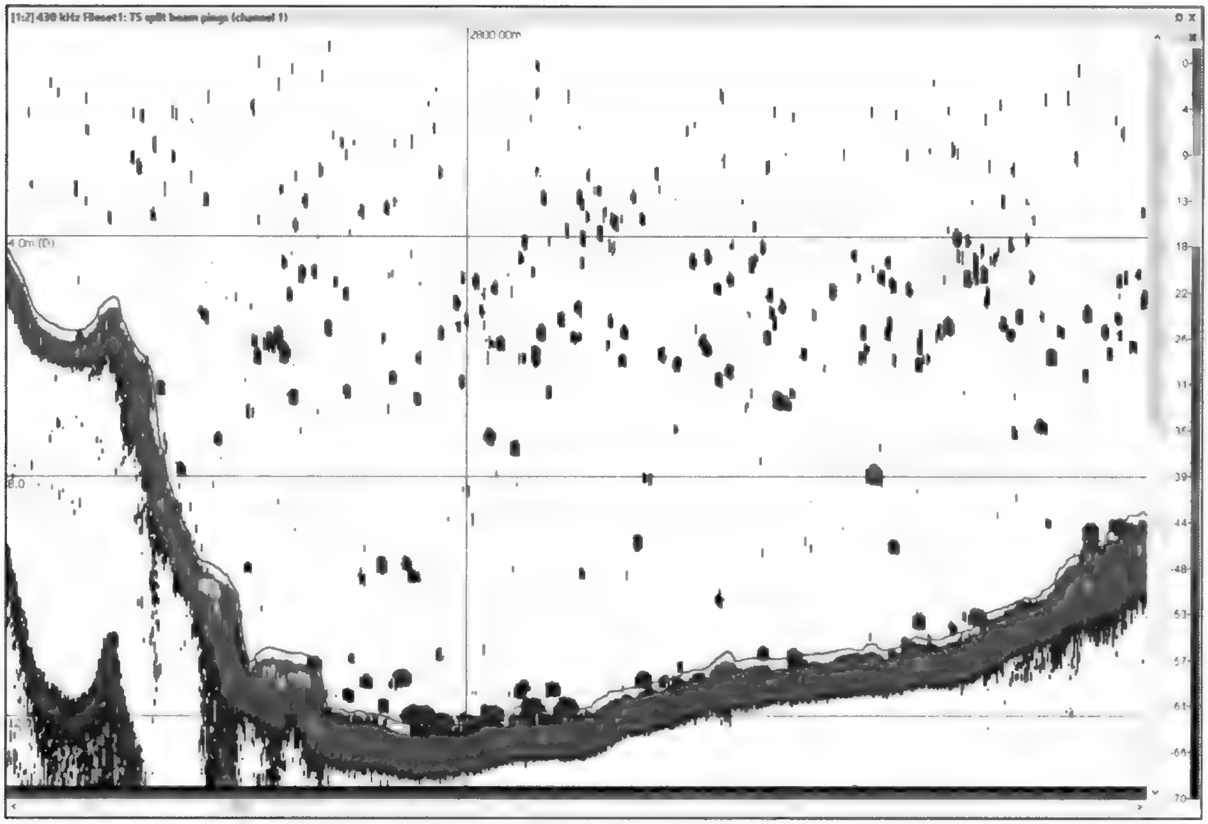


Figure 5. Echogram in Echoview showing bottom and mid-water fish echoes

In the echogram above, a green line just above the bottom (Fig. 5) separates the bottom signal from the water column. The empty water column above the bottom is white, while the fish-like echoes are the blue and black clusters. Echoview software (v 9) was used to process the collected data. It automatically finds the bottom, and clusters the single echoes above the bottom into distinct entities called tracks. The single echoes and tracks are chosen using a set of rules supplied by the user. Single targets are then generated from the TS and angular position acoustic data contained in the acoustic file. A -65 dB analysis threshold was applied to the single target data. Candidate fish tracks are then generated from the single target data and exported into a spreadsheet, along with information about sample volume, transect distance, and fish track density. The population estimate is based on a -60 dB and greater fish tracks to replicate what was done in the previous studies. All final calculations were made in Excel.

Volumetric candidate fish track density (fish/m^3) was calculated for each 100 m horizontal distance interval and for three depth (<2 m, 2-4 m and >4 m) intervals. Volumetric density was then multiplied by the mean interval depth to calculate the areal density (fish/m^2). The calculated areal density was then multiplied by the surface area that the interval was extrapolated out to; each interval density was extrapolated out to 5 m on each side (a total of 10 m) of the interval. This calculation resulted in the fish population estimate for that interval (Simmonds and MacLennan 2005). The total fish area population

estimate was calculated by adding together the individual interval population estimates in the survey area. Since some of the intervals were less than 100 meters in length, the individual interval volumes were weighted by what percentage each interval sample volume was, based on the mean interval sample volume. For example, if the mean interval sample volume for the survey was 400 cubic meters, and the sample volume for a particular interval was 100 cubic meters, then the density of that interval would be multiplied by 0.25 (100/400). This prevents small volume intervals from disproportionately influencing the final population estimate. The 95% confidence interval (CI) was calculated using the CONFIDENCE.NORM Excel function. The fish TS to length conversion equation used was:

$$L = \sqrt[1.88]{\frac{10^{(TS \div 10)} \times 4\pi}{0.007304^2 \times 0.021}} \times 0.007304$$

This equation is based on Love's 1971 all aspect target strength to length equation (Love 1971) and is the same equation used in the previous studies. The minimum fish length included in the population estimate, based upon the -60 dB fish track threshold, is 45.3 mm.

Figures 6 and 7 show the TS distributions of the detected candidate fish tracks for night surveys 1 and 2.

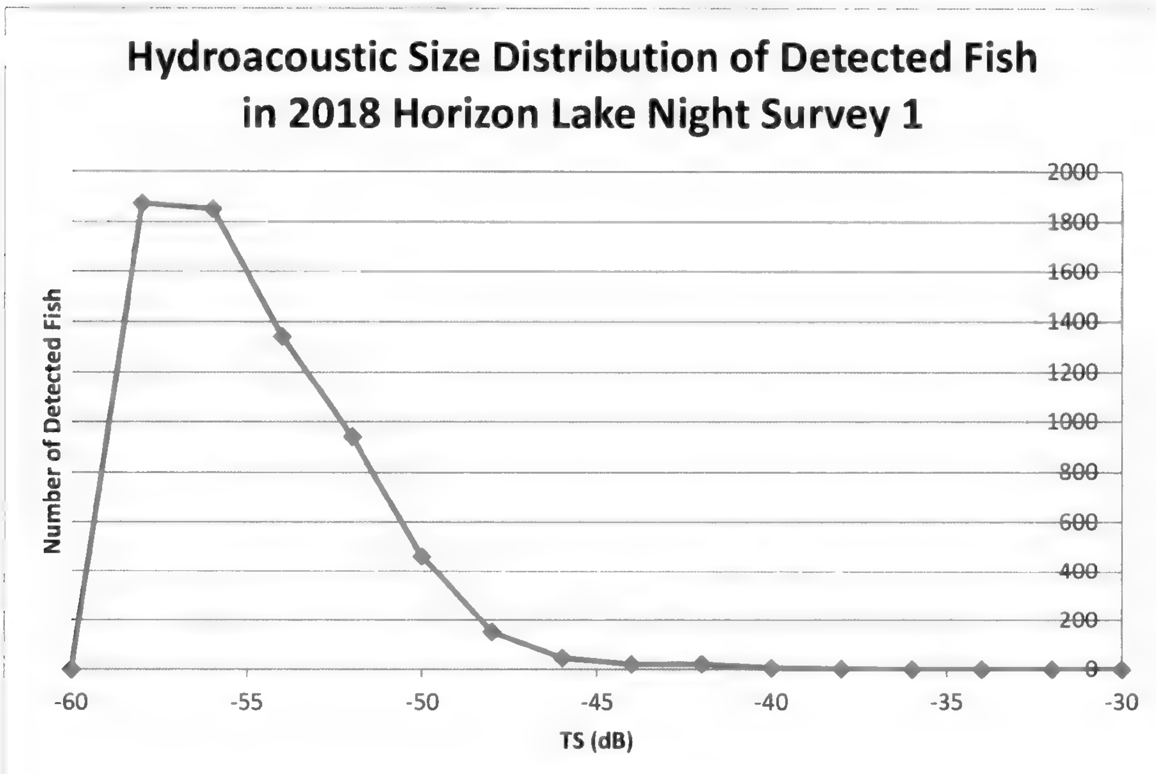


Figure 6. TS distribution of fish in 2018 Horizon Lake Night Survey 1

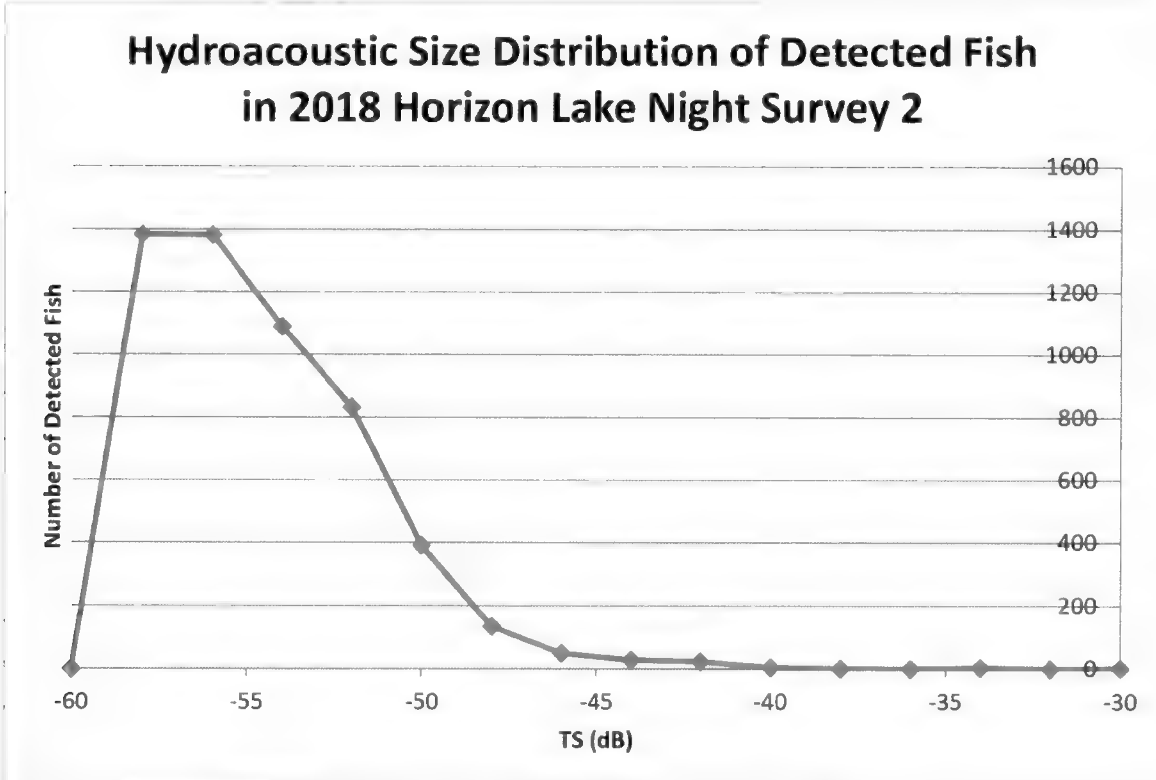


Figure 7. TS distribution of fish in 2018 Horizon Lake Night Survey 2

The next two charts show the target strength to length distributions for both night surveys.

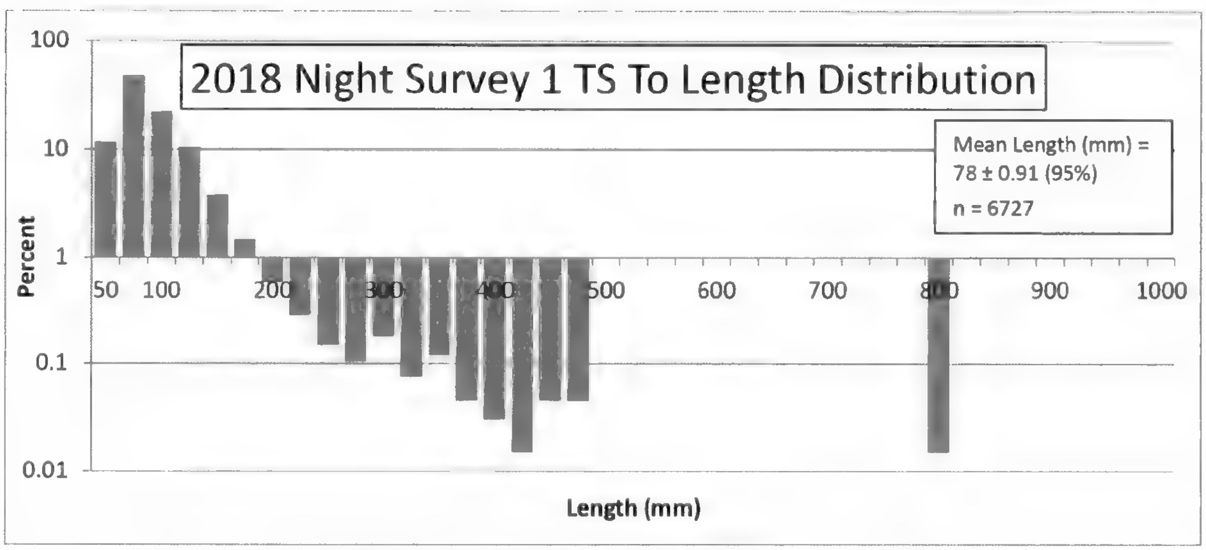


Figure 8. Night 1 estimated length distribution derived from hydroacoustic fish track dorsal aspect TS

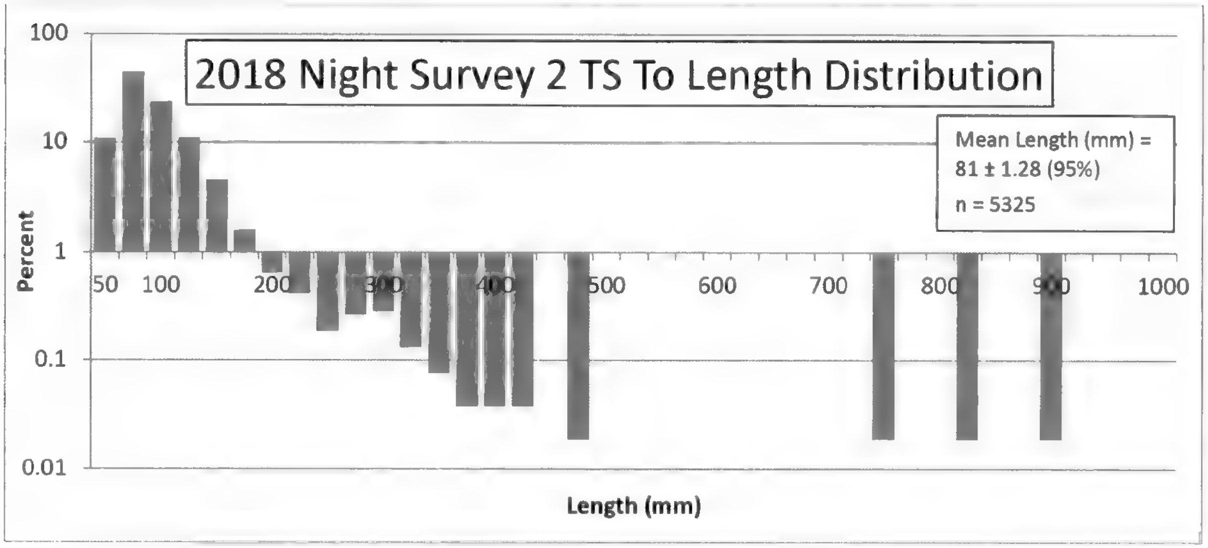


Figure 9. Night 2 estimated length distribution derived from hydroacoustic fish track dorsal aspect TS

The estimated length distributions of the night surveys were very similar. The number of detected fish tracks on Night 1 was higher than on Night 2.

Survey	Unweighted Population Estimate	Weighted Population Estimate
Night 1	132097	156918
Night 2	113563	122608
95% CI (±)	18163	33623
Note: The 95% CI does not apply to the day time survey population estimate		

Table 1. Population estimate of fish from 2018 Horizon Lake hydroacoustic survey

Table 1 shows the population estimate of fish in Horizon Lake broken down by survey and by unweighted/weighted.

Survey	≤4 m			>4 m			Depth Layers Combined		
	Mean (mm)	SD	Count	Mean (mm)	SD	Count	Mean (mm)	SD	Count
Night 1	69.5	44.5	995	79.7	37.9	5731	78.2	38.1	6726
Night 2	74.7	47.6	1047	82.8	46.8	4278	81.2	47.6	5325
Combined	72.2	42.6	2042	81	42.1	10009	79.5	42.6	12051

Table 2. Statistics for Fish Length Derived from Target Strengths of Fish Estimated from Hydroacoustic Transects per Survey

Table 2 shows the calculated target strength to length statistics of the two night surveys, broken down by depth layers – 4 m and less, and greater than 4 m.

Table 3 shows the population estimates for individual species based on the percent species composition of the catch data summarization supplied to BioSonics by Hatfield.

Species	Population Estimates			
	Night 1	Night 1 unweighted	Night 2	Night 2 unweighted
ARGR	6204	5223	4848	4490
BRST	14994	12622	11715	10851
FTMN	73935	62240	57769	53508
LKCH	24559	20674	19189	17774
LNSC	517	435	404	374
TRPR	20423	17192	15957	14780
WHSC	16286	13710	12725	11787

Table 3. Horizon Lake Species Species Percent Composition Based on Catch Data and Fish Densities Calculated Using Hydroacoustic Data from the 2018 Hydroacoustics Study

References

Love, R.H. (1971) Dorsal aspect target strength of an individual fish. *J. Acoustic. Soc.Am.***49,** 816-23.

Simmonds, J.E., MacLennan, D.N. (2005) *Fisheries Acoustics Theory and Practice- second ed.* Oxford, UK (Blackwell Publishing).

Appendix A6

Stantec eDNA Letter

Stantec

Stantec Consulting Ltd.
200-325 25 Street SE, Calgary AB T2A 7H8

January 30, 2019
File: 123512903

Attention: Joanne Hogg, Lead, Research
Canadian Natural Horizon Oil Sands
Office 780.824.2076 | Cell 780.714.4955
Joanne.Hogg@cnrl.com

Dear Joanne,

Reference: Horizon Oil Sands Mine Project Environmental DNA Sampling Program for Arctic Grayling and Burbot

INTRODUCTION

Canadian Natural Resources Ltd. (Canadian Natural) retained Stantec Consulting Ltd. (Stantec) to complete an environmental DNA (eDNA) sampling program at the Horizon Mine north of Fort McMurray, Alberta (the Project). The Project was developed with a focus on detecting the presence of Arctic grayling (*Thymallus arcticus*) and burbot (*Lota lota*) within the Tar River and Horizon Lake. The Project was designed to test the potential for eDNA sampling to be used as part of ongoing biomonitoring programs at Horizon Mine.

Samples from Horizon Lake and the Tar River were sent to Precision Biomonitoring Inc. (PBI), a research partner of Stantec's, for analytical testing of the samples. PBI also developed a species-specific assay for testing for the presence of Arctic grayling eDNA, which was used for the Project.

BACKGROUND

Horizon Lake is a compensation lake designed and built by Canadian Natural as a condition of the *Fisheries Act* Authorization for the Horizon Mine. Horizon Lake contains spawning, rearing, and overwintering habitat for several fish species found within the Athabasca River watershed, including Arctic grayling and burbot.

The Tar River flows into the northwest corner of Horizon Lake and flows out of a control structure at the east side of the lake. Canadian Natural constructed a hydraulic jump structure upstream from the lake inlet to increase pool habitat in the Tar River, a key habitat type for Arctic grayling. Canadian Natural monitors Arctic grayling movement in the Tar River using telemetry; both upstream and downstream of the constructed fish habitat.

Canadian Natural monitors fish populations in Horizon Lake to demonstrate the effectiveness of Horizon Lake as an offsetting (i.e., compensation) measure. The eDNA sampling at the Tar River and Horizon Lake was conducted concurrently with the ongoing fish population study in order to test the ability of eDNA to detect the presence of Arctic grayling in areas where have been captured during the ongoing monitoring program.

Arctic grayling and burbot are found in the Athabasca River watershed and specifically in the Tar River system (Nelson and Paetz 1992; Scott and Crossman 1998; Alberta Environment and Parks [AEP] 2018), which flows into the Athabasca River.

The Arctic grayling is designated sensitive under the General Status of Alberta Wild Species (AEP 2017) and a species of special concern by Alberta's Endangered Species Conservation Committee (Government of Alberta [GOA] 2016). Arctic grayling is a cool to cold-water fish species that prefers mid to large clear freshwater rivers and lakes. They overwinter in deep pools or lakes downstream from their summer feeding areas and migrate in the early spring to rocky streams for spawning and subsequently to summer feeding areas (Nelson and Paetz 1992; Scott and Crossman 1998; McPhail 2007).

The burbot is designated secure under the General Status of Alberta Wild Species (AEP 2017). Burbot prefer deep water and large cobble substrate. Burbot spawn in lakes and streams, mid-winter (between November and May) over fine to gravel substrates in shallow water (0.3 to 3.0 m of water) ((Nelson and Paetz 1992; Scott and Crossman 1998; McPhail 2007). Burbot is a species that has historically low capture rates during conventional fish sampling programs (AEP 2018).

METHODS

SAMPLING SITES

Sampling sites in the Tar River and Horizon Lake were selected for areas where Arctic grayling and burbot were expected to occur based preferred habitat at the time of sampling, locations where the species have been historically captured, or where Arctic grayling were captured just prior to eDNA sampling (as part of the ongoing fish population study at Horizon Lake). Where appropriate, sample sites were aligned with the same locations where fish sampling occurs as part of the long-term fish population monitoring program at Horizon Lake.

Two sites were selected for eDNA sampling in the Tar River (Table 1). The sites were at the outflow from the pools upstream and downstream of the constructed hydraulic jump structure (see Attachment A). Tagged Arctic grayling are known to move through these areas.

Sampling for eDNA was completed at six sites in Horizon Lake (Table 1). Three samples were collected from the pelagic zone (> 2.5 m water depth) and three were collected from the littoral zone (< 2.5 m water depth) (see Attachment A).

Reference: **Horizon Oil Sands Mine Project Environmental DNA Sampling Program for Arctic Grayling and Burbot**

Table 1 October 2018 Environmental DNA Sampling Sites

Site ID	Waterbody	Sampling Site Location (UTM Zone 12, NAD83)		Site Water Depth (m)[1]	Subsample Depths (m)[2]
		Easting	Northing		
Tar-1	Tar River	441012	6361432	0.4	0.1
Tar-2	Tar River	440916	6361487	0.2	0.1
HZL-1	Horizon Lake	442292	6360746	18	12
					6
					1
EDNA-1	Horizon Lake	441544	6361232	5.5	4
					2.5
					1
EDNA-2	Horizon Lake	442389	6360956	1.5	0.75
					0.75
					0.75
EDNA-3	Horizon Lake	441327	6361422	2	1
					1
					1
EDNA-4	Horizon Lake	442457	6360744	6.3	5
					3
					1
EDNA-5	Horizon Lake	442653	6360813	2	1
					1
					1
ConAG-1a	Positive control for Arctic grayling[3]	NA	NA	NA	NA
ConAG-1b	Duplicate positive control for Arctic grayling[3]	NA	NA	NA	NA
ConAG-2	Positive control for Arctic grayling[3]	NA	NA	NA	NA
ConN-1	Negative control (deionized water)	NA	NA	NA	NA

Reference: Horizon Oil Sands Mine Project Environmental DNA Sampling Program for Arctic Grayling and Burbot

Table 1 October 2018 Environmental DNA Sampling Sites

		Sampling Site Location (UTM Zone 12, NAD83)			
Site ID	Waterbody	Easting	Northing	Site Water Depth (m)[1]	Subsample Depths (m)[2]

NOTES:
[1] Lake littoral/pelagic zones division is at approximately 2.5 m
[2] Subsamples were combined into one composite sample for each site
[3] Arctic grayling positive controls consisted of sampling water used for holding Arctic grayling captured in Horizon Lake
NA = not applicable

SAMPLING METHODS

Water samples for eDNA analysis were collected from the Tar River and Horizon Lake from October 5-6, 2018. Water grab samples were also collected at sites EDNA 3, EDNA 4, and EDNA 5 and submitted to Maxxam Analytics for analysis of dissolved organic carbon (DOC) and total suspended solids (TSS). Tannins and Lignins were analyzed from a water sample collected at site HZL-1. These parameters have the potential to interfere with eDNA extraction and/or analysis. Laboratory methods and QA/QC protocols for water chemistry are described in Attachment C.

The eDNA sampling methods used for the Horizon Lake and Tar River assessment were based on eDNA sampling protocols from British Columbia (Hobbs et al. 2017) and United States Geological Survey (Matthew et al. 2012). Sampling was conducted by a qualified Stantec Aquatic Scientist trained in eDNA sampling design and field methods, assisted by a Canadian Natural representative.

Prior to eDNA sampling, field equipment (e.g., Kemmerer sampler and buckets) was decontaminated with a 10% bleach solution and triple-rinsed with water from the first site sampled (Tar-1). When collecting a sample, field personnel wore clean nitrile gloves, all containers were pre-cleaned with 10% bleach solution, re-cleaned with a 10% bleach solution between sites, and then triple-rinsed with water from the next site. The samples were placed in high-density polyethylene (HDPE) plastic containers which were labeled with the site identification, collection date and time. The eDNA samples were kept cold until filtration. Site location and descriptions were logged in a field note book.

Each Horizon Lake eDNA sample was a composite 6 litre (L) sample made from three – 2 L subsamples collected using a Kemmerer sampler. Pelagic zone subsamples were collected approximately 1 m from the bottom, mid water column, and 1 m below the lake surface (see Table 1). Littoral zone subsamples were collected 1 m below the surface or mid water column as appropriate (see Table 1). Tar River samples were single 4 L samples collected at one site (see Table 1).

Arctic grayling caught during the concurrent Horizon Lake fish survey were held in two separate pails of lake water. The water from each pail (after fish were relocated) was used for the two positive control samples, including a duplicate from one pail (see Table 1). Deionized water was used as the negative control sample (absence of fish eDNA).

The samples were filtered in a clean facility (Horizon Mine on-site environmental lab) within 24 hours of sample collection to reduce the potential for eDNA degradation. To prevent cross-contamination between samples, clean disposable nitrile gloves were used, and equipment was pre-cleaned prior to filtration. Samples were filtered through single-use sterile 47 mm, 5 µm nitrocellulose filters using an ANDe™ peristaltic pump. Following filtration, each filter was removed while wearing clean nitrile gloves and using sterilized single-use tweezers. Each filter was folded and placed in a pre-labeled sterile envelope, placed in a zip-loc bag with desiccant, and frozen at -20°C.

The filters were shipped over-night to Precision Biomonitoring Inc. (PBI) in Guelph, Ontario for eDNA analysis. Upon receipt, filters were confirmed to be intact; however, the filters had thawed during shipment (Thomas 2019, pers. comm). PBI's analytical procedures follow a quality assurance and quality control plan that prevents cross-contamination of samples during analysis and verifies that quality control steps are in place for each step of sample analysis. PBI's analyses are verified by a third-party lab accredited by the International Organization for Standardization (ISO/IEC 17025) (Thomas 2019, pers. comm.).

PBI uses sensitive species-specific assays for Arctic grayling and burbot that were developed and validated by the Biodiversity Institute of Ontario (BIO) and PBI. Extraction of eDNA from the filters was completed October 17, 2018 and extracts were immediately stored at 4 °C until the qPCR step. Analyses for all sites was completed October 18, 2018. Residual sample extracts have been archived at PBI for future analysis, if and as warranted. Analytical methods are described in the eDNA Survey Report (see Attachment B).

QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance/quality control (QA/QC) protocols for the eDNA sampling program included:

- Sampling by Stantec staff trained in eDNA sampling design and field methods
- Use of a published protocol for sampling
- Decontamination of sampling equipment, using a 10% bleach solution, prior to sampling and again between sample sites
- Avoidance of contact with site water other than with clean gloves and supplies
- Use of a filtration blank sample as a negative control
- Collection of positive field control samples
- Filtration of samples within 24 hours of collection to prevent sample degradation
- Use of chain of custody forms to track sample collection, filtering, shipment and submission for laboratory analysis.
- Use of a qualified lab for eDNA extraction and analyses

RESULTS

During the field assessment, a relatively high proportion of suspended particulate matter was observed in the Horizon Lake water column compared to the Tar River. The windy conditions that were creating waves in the lake could have been a major contributing factor for suspending particulate matter. Recorded water temperature at the surface of Horizon Lake ranged from 4.5 - 4.8°C. Analytical results for DOC and TSS for three sites at Horizon Lake are listed in Table 2. Total tannins and lignins were 0.92 mg/L at site HZL-1. See Attachment C for detailed analytical results for water chemistry.

Table 2 Water Chemistry Results

Site ID	DOC (mg/L)	TSS (mg/L)
EDNA 3	17	8.7
EDNA 4	18	6.7
EDNA 5	16	11

During eDNA analysis PBI implemented QA/QC protocols including the use of positive amplification controls to verify qPCR assay performance, no template controls to detect the potential presence of sample or reagent contamination, and duplicate reactions to test for PCR inhibition using an external positive control. The QA/QC protocols confirmed the species-specific assay performance and the absence of contamination (see Attachment B for additional details). Inhibition was observed in the eDNA sample from one site: EDNA 3; however, inhibition was successfully removed for sample analysis using species-specific assays (see Attachment B).

All three positive controls for Arctic grayling (sample IDs ConAG-1a, ConAG-1b, and ConAG-2) had 100% positive detection of Arctic grayling eDNA (Table 3; Attachment B). The negative control had 0% detection of either Arctic grayling or burbot (Table 3; Attachment B). The controls provide verification that the eDNA sampling method is effective at collecting eDNA from a site where the target species is known to be present, that decontamination procedures were effective, and that the species-specific Arctic grayling assay is working effectively.

EDNA-3, located in Horizon Lake near the inlet of the Tar River, was the only site that had a positive detection of Arctic grayling eDNA (Table 3; Attachment B). Arctic grayling was captured at EDNA-3 and EDNA-5 during the conventional sampling program the previous day. However, detection of Arctic grayling eDNA at EDNA-5 was negative (Table 3; Attachment B).

None of the sites had positive detection of burbot eDNA (Table 3; Attachment B) and burbot were not captured during the conventional sampling program prior to eDNA sampling.

Table 3 October 2018 Environmental DNA Results

Site ID[1]	Waterbody	Arctic Grayling eDNA Detection	Burbot eDNA Detection
Tar – 1	Tar River	-	-
Tar – 2	Tar River	-	-
HZL1	Horizon Lake	-	-
EDNA 1	Horizon Lake	-	-
EDNA 2	Horizon Lake	-	-
EDNA 3	Horizon Lake	Positive	-
EDNA 4	Horizon Lake	-	-
EDNA 5	Horizon Lake	-	-
ConAG - 1a	Positive control for Arctic grayling1	Positive	-
ConAG - 1b	Duplicate positive control for Arctic grayling[1]	Positive	-
ConAG – 2	Positive control for Arctic grayling[1]	Positive	-
ConN – 1	Negative control (deionized water)	-	-

NOTES:
- Species-specific eDNA not detected
[1] See Attachment A for site locations
[2] Arctic grayling positive controls consisted of sampling water used for holding Arctic grayling captured in Horizon Lake

CONCLUSIONS

Sampling for eDNA was used to augment conventional fish sampling to determine the presence of Arctic grayling and burbot in the Tar River and Horizon Lake. Arctic grayling eDNA was detected at one site (EDNA-3) and burbot eDNA was not detected at any of the sample sites. Potential explanations for no detection of Arctic grayling and burbot eDNA at sites include:

- Low abundance or absence of the target species in the vicinity of the sample sites at the time of field sampling.
- Low concentration of DNA in the lake below the limit of detection for the assay (16.2 DNA copies/µL; see Attachment B). This may be due to a low rate of DNA "shedding" to the environment or a high rate of DNA degradation (the latter is considered unlikely due to low water temperatures).

Several factors could influence the concentration of Arctic grayling and burbot eDNA in the Tar River and Horizon Lake:

- Rates of eDNA production (from fish to water) can be affected by diet (Klymus et al. 2015). A shift in habitat use and food sources between summer to fall could affect the production of eDNA in Horizon Lake; particularly, for Arctic grayling (Cutting et al. 2016).
- Upon returning to Horizon Lake for overwintering, the concentration of eDNA in water might be below the limit of detection for of the target species (i.e., fish that are present in Horizon Lake haven't been there long enough to shed a detectable amount of eDNA).
- Fall mixing of Horizon Lake could dilute the concentration of eDNA within the lake. Combined with potentially limited diffusion of eDNA through the water column (Takahara et al. 2012) the concentration of eDNA in the filtered samples could have been below the detection limit.
- Chemical interference during qPCR; particularly, from the presence of suspended sediment and humic or tannic acids can inhibit the amplification of eDNA during qPCR (Kontanis and Reed 2006; Green & Field 2012; Stoeckle et al. 2017). Samples from the present study were tested for inhibition but only one site (EDNA 3) had observed inhibition, which did not appear to influence the results. A trend in DOC and TSS among sites that would suggest that inhibition of eDNA amplification was not present (see Table 2).

The eDNA sampling program conducted in October 2018 was a pilot study to examine the potential value of using eDNA sampling in future monitoring programs. The eDNA sampling program in October 2018 corroborated the results of the conventional sampling program for two target species. This demonstrates that eDNA sampling is an effective method for detecting fish presence. Information from the eDNA pilot study in 2018 provides valuable baseline information to inform the design of future sampling programs to optimize the probability of detection of eDNA of target species.

We recommend for future monitoring programs that eDNA sampling be conducted just before conventional sampling is conducted to avoid a "sampling effect" wherein eDNA associated with sampling equipment is distributed across sites and could result in false positives. Sampling prior to fall mixing or during the winter (under ice) could reduce the potential loss of eDNA to sediment; whereby, eDNA adsorbs to suspended solids, settles out of the water column, and is stored in sediment.

Remaining sample extracts from 2018 can be used to determine the presence of eDNA from other species, using metabarcoding to provide information on the occurrence of other aquatic species at or near the sampling sites.

CLOSING

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Please feel free to contact Stantec with any questions.

Regards,

Stantec Consulting Ltd

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Attachment: A – Horizon Lake and Tar River Environmental DNA Sampling Sites
B – Environmental DNA Survey Report from Precision Biomonitoring Inc.
C – Water Chemistry Results from Maxxam

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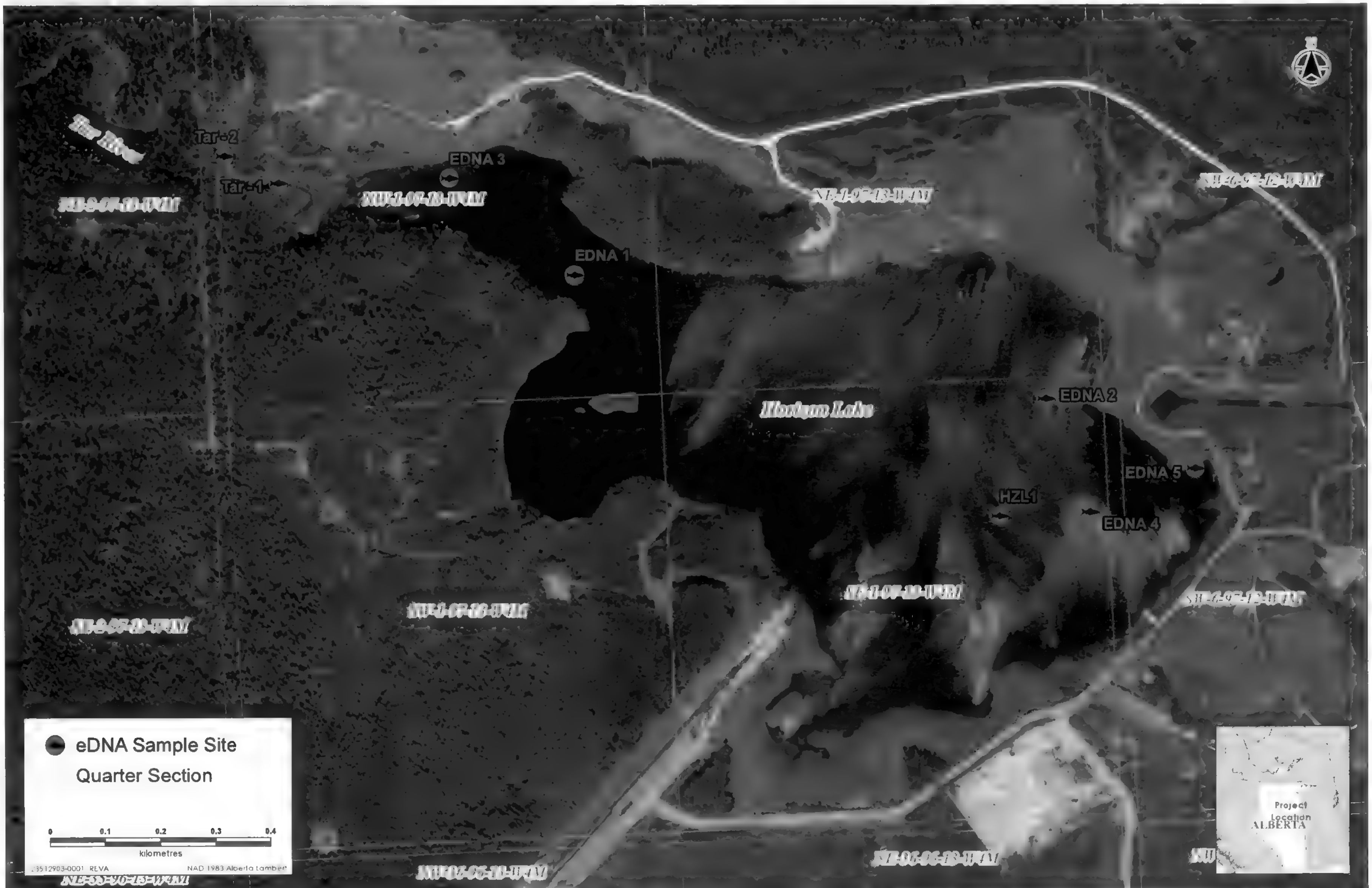

Sources: Base Data provided by AltaLIS

Disclaimer: The map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

eDNA Sampling Locations in the Tar River and Horizon Lake

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HORIZON OIL SANDS MINE ENVIRONMENTAL DNA PROJECT

Figure 1

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Environmental DNA Survey Report

Report Issued: 07/01/2019

Prepared By: Louis Gasparini	Date: 07/01/2019	Email: [redacted]
Approved By: Steve Crookes	Date: 07/01/2019	Email: steve.crookes@precisionbiomonitoring.com

Report Contents

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Customer

Stantec Consulting Ltd.

Contact Name	Email Address	Phone
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Greg Schatz	[redacted]	
Pamela Reece		

Project

Project Title: Canadian National Resources Ltd. (CNRL) Horizon Mine eDNA Sampling

Purchase Order: 123512903

Purpose: Analysis of eDNA samples to determine the presence or absence of arctic grayling (*Thymallus arcticus*) and burbot (*Lota lota*).

Sample Information (For additional sample information see Sample Information Table on page 2.)

Sample Collection Conducted by: Stantec Consulting Ltd.

Sampling Personnel: Pamela Reece

Sampling Period: 05/10/2018 – 06/10/2018

Sampling Apparatus: ANDe

Filter Pore Size: 5 µm

Sample Shipment Format: Filters, desiccated

Date Shipped: 10/10/2018

Samples Received By: Louis Gasparini

Date Received: 11/10/2018

Condition of Samples Upon Receipt: Intact

Analysis

Analysis Requested: qPCR for detection of arctic grayling (*Thymallus arcticus*) and burbot (*Lota lota*).

Analysis Conducted By: Louis Gasparini

Analysis Location: University of Guelph, 50 Stone Rd E, Guelph, ON, N1G 2W1

Date of Analysis: 18/10/2018

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Sample Information Table.

Project: Canadian National Resources Ltd. (CNRL) Horizon Mine eDNA Sampling				**Extraction Conducted by:** Precision Biomonitoring Inc.				**Extraction Location:** University of Guelph		
Sample	**Date Filtered**	**Time Filtered**	**Filter Preservation Method**	**Date Shipped**	**Date Received**	**Date of Sample Extraction**	**Time of Sample Extraction**	**Extract Storage Condition**	**Date of Sample Analysis**	**Time of sample Analysis**
Tar – 1	05/10/2018	08:45	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:00	4 °C	18/10/2018	15:41
Tar – 2	05/10/2018	09:22	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:00	4 °C	18/10/2018	15:41
ConN – 1	05/10/2018	08:00	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:00	4 °C	18/10/2018	15:41
HZL1	05/10/2018	11:10	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:00	4 °C	18/10/2018	15:41
EDNA 1	05/10/2018	11:44	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:00	4 °C	18/10/2018	15:41
EDNA 2	05/10/2018	12:06	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:00	4 °C	18/10/2018	15:41
ConAG – 1a	05/10/2018	14:40	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:20	4 °C	18/10/2018	15:41
ConAG – 1b	05/10/2018	14:40	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:20	4 °C	18/10/2018	15:41
EDNA 3	06/10/2018	10:14	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:20	4 °C	18/10/2018	15:41
EDNA 4	06/10/2018	10:41	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:20	4 °C	18/10/2018	15:41
EDNA 5	06/10/2018	10:51	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:20	4 °C	18/10/2018	15:41
ConAG-2	06/10/2018	18:00	Desiccant	10/10/2018	11/10/2018	17/10/2018	11:20	4 °C	18/10/2018	15:41

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Methods

qPCR Assay Design

Two TripleLock™ qPCR assays were designed and validated to detect arctic grayling (*Thymallus arcticus*) or burbot (*Lota lota*) eDNA. For complete assay design and validation methodology see Appendix i and ii.

Table 1: Parameters of *T. arcticus* qPCR assay on the MIC Thermal Cycler. For full documentation see Appendix i.

Assay Parameter	Validated Result
Limit of Detection	16.2 copies/µL
Limit of Quantification	16.2 copies/µL
Efficiency	95.15%

Table 2: Parameters of *L. lota* qPCR assay on the MIC Thermal Cycler. For full documentation see Appendix ii.

Assay Parameter	Validated Result
Limit of Detection	1.01 copies/µL
Limit of Quantification	1.01 copies/µL
Efficiency	98.0%

Sample preservation/shipping

Filters were dried and preserved using a desiccant and shipped to the University of Guelph. Samples were intact upon receipt.

eDNA Extraction from Filters

eDNA extraction was conducted in the Robert Hanner Lab at the University of Guelph. eDNA was extracted and purified from filters using the Biomeme M1 Sample Prep Kit (Biomeme Inc., cat. No 3000014). Extracts were immediately stored at 4 °C until qPCR.

qPCR

Targeted qPCR was conducted using a MIC thermal cycler (Biomolecular Systems) to detect either *T. arcticus* or *L. lota* using customized thermal cycling conditions (see Appendix i and ii). Positive amplification controls (PAC) consisting of reactions containing the target DNA fragment were included in each qPCR run to verify qPCR assay performance. No-template controls (NTC) were included in each qPCR run to detect the potential presence of sample or reagent contamination during analysis. Each qPCR reaction was 20 µL, consisting of 15 µL of customized master mix and 5 µL of eDNA extract.

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Prior to targeted qPCR a set of duplicate reactions were run for each sample to test for PCR inhibition using an external positive control (EPC). If PCR inhibition is not identified using a control the analysis can lead to false negative results. The EPC is set up such that a delay in the mean EPC Cq value for a reaction containing eDNA extract, relative to reactions containing pure water, of 1 or more is indicative of PCR inhibition. If inhibition was present, eDNA extracts were run raw and diluted 1:3 in pure water for targeted qPCR.

Results

Inhibition

Inhibition was observed in one sample: EDNA 3 as indicated by the delay of 1.9 in the mean Cq of the EPC relative to the pure water control. This sample was diluted 1:3 in pure water which removed inhibition (See Table 3).

Table 3: Results of external positive control reactions to determine the presence of PCR inhibition in eDNA extracts.

Sample	Mean EPC Cq	Inhibition Present
Pure Water	30.0	N/A
Tar – 1	30.1	NO
Tar – 2	30.1	NO
ConN – 1	30.1	NO
HZL1	30.2	NO
EDNA 1	30.1	NO
EDNA 2	30.4	NO
ConAG – 1a	30.1	NO
ConAG – 1b	30.3	NO
EDNA 3	32.0	YES
EDNA 4	30.0	NO
EDNA 5	30.4	NO
ConAG-2	30.6	NO
ENDA 3 1:3	30.3	NO

N/A: Not Applicable.

T. arcticus qPCR

T. arcticus eDNA was detected in 4 samples (ConAG – 1a, ConAG – 1b, ConAG – 2, EDNA 3) which were 100% positive across all technical replicates. Additionally, the 1:3 dilution of sample EDNA 3 had positive amplification in two of three technical replicates (see Table 4). All PAC reactions were positive with expected Cq values indicating proper assay performance. All NTC reactions were negative indicating no contamination during analysis.

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Table 4: Results of *T. arcticus* targeted qPCR.

Sample	Technical Replicate Cq Values			Mean Cq of Positive Reactions
	1	2	3	
Tar – 1	-	-	-	-
Tar – 2	-	-	-	-
ConN – 1	-	-	-	-
HZL1	-	-	-	-
EDNA 1	-	-	-	-
EDNA 2	-	-	-	-
ConAG – 1a	21.26	21.32	21.10	21.22
ConAG – 1b	21.90	21.93	22.02	21.95
EDNA 3	34.29	36.75	34.63	35.22
EDNA 4	-	-	-	-
EDNA 5	-	-	-	-
ConAG-2	22.48	22.29	22.28	22.35
ENDA 3 1:3	-	35.25	40.43	37.84
PAC	20.46	N/A	N/A	20.46
NTC	-	-	N/A	-

- : no Cq value obtained. N/A: Not Applicable.

<u>*L. lota* qPCR</u>

There was no amplification of *L. lota* eDNA observed in any of the samples (See Table 5). All PAC reactions were positive with expected Cq values indicating proper assay performance. All NTC reactions were negative indicating no contamination during analysis.

Table 5: Results of *L. lota* targeted qPCR.

Sample	Technical Replicate Cq Values			Mean Cq of Positive Reactions
	1	2	3	
Tar – 1	-	-	-	-
Tar – 2	-	-	-	-

Sample	Technical Replicate Cq Values			Mean Cq of Positive Reactions
	1	2	3	
ConN – 1	-	-	-	-
HZL1	-	-	-	-
EDNA 1	-	-	-	-
EDNA 2	-	-	-	-
ConAG – 1a	-	-	-	-
ConAG – 1b	-	-	-	-
EDNA 3	-	-	-	-
EDNA 4	-	-	-	-
EDNA 5	-	-	-	-
ConAG-2	-	-	-	-
ENDA 3 1:3	-	-	-	-
PAC	21.22	N/A	N/A	21.22
NTC	-	-	N/A	-

- : no Cq value obtained. N/A: Not Applicable.

Conclusion

- Tests for inhibition indicated that sample EDNA 3 had PCR inhibitors present as shown by the delay of 1.9 in the mean Cq of the EPC relative to the pure water control (see Table 3).
- Multiple positive detections of *T. arcticus* were obtained. Three samples (ConAG – 1a, ConAG – 1b, and ConAG -2) had low Cq values indicating a high amount of *T. arcticus* eDNA in the sample. This suggests a strong presence of *T. arcticus* eDNA at the sites where these samples were obtained.
- *T. arcticus* eDNA was detected in sample EDNA 3 for which all three technical replicates were positive when run raw and for which two of three technical replicates were positive when diluted 1:3. This suggests the presence of *T. arcticus* at the site where this sample was obtained.
- *L. lota* eDNA was not detected in any of the samples. This suggests a very low abundance of *L. lota* eDNA, below limits of detection, or that *L. lota* is potentially absent from those sites.

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Appendix i: Arctic grayling (*Thymallus arcticus*) TripleLock™ qPCR Assay Documentation

The Precision Biomonitoring TripleLock™ *Thymallus arcticus* qPCR assay for eDNA is a real-time PCR (qPCR) TaqMan assay, designed for the detection of Arctic grayling (*Thymallus arcticus*) environmental DNA (eDNA) from filtered water samples.

Technical specifications

The *T. arcticus* qPCR assay for eDNA is species-specific and contains proprietary formulation of primers, probes and master mix. The recommended qPCR cycling protocol is shown in Table A1.

Table A1. Recommended cycling protocol for the *T. arcticus* qPCR assay.

Step	Parameter
Initial Denature	2 min @ 95°C
Cycles	40
Denature	15 seconds @ 95°C
Anneal	45 seconds @ 57°C

General eDNA assay information

The TripleLock™ *T. arcticus* qPCR assay uses a 83 bp fragment from the *cytochrome c oxidase subunit I* (COI) mitochondrial marker to detect Arctic grayling in real time. The assay has been successfully Lab and field validated following the *Minimum Information for Publication of Quantitative Real-Time PCR Experiments* (MIQE) guidelines (Bustin *et al.* 2009). The validation includes testing specificity, sensitivity, and efficiency. Specificity was verified using DNA samples from the target species and from non-target species. Sensitivity and efficiency have been established by means of standard curves. Sensitivity is expressed as the limit of detection (LOD), which is the minimum DNA concentration that can be detected with 95% of confidence (Bustin *et al.* 2009). The limit of quantification (LOQ) the lowest concentration of target that can be accurately quantified with a coefficient of variance below a threshold of ≤35% obtained from calculated copy number from replicates in an assay specific standard curve (Forootan et al. 2017). The *T. arcticus* assay has a LOD= 16.2 copies/µL and LOQ = 16.2 copies/µL.

The *T. arcticus* assay was validated using the MIC thermal cycler (Biomolecular Systems).

Assay specificity test

Specificity of the *T. arcticus* qPCR assay was tested using DNA samples from the target species (*T. arcticus*) and from four non-target species (Table A2).

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Table A2. Species used in the specificity test of the *T. arcticus* qPCR assay

Species	Number of samples used	Detection with the standardized qPCR *T. arcticus* assay
Arctic grayling *T. arcticus* (target)	10	Yes
Atlantic whitefish *Coregonus huntsman* (non-target)	1	No
Arctic char *Salvelinus alpinus* (non-target)	1	No
Atlantic salmon *Salmo salar* (non-target)	1	No
Cutthroat trout *Oncorhynchus clarkii* (non-target)	1	No
No template control	1	No

Assay sensitivity and efficiency test

The validation of the *T. arcticus* assay was assessed with standard curves performed using the MIC thermal cycler (Bio Molecular Systems).

Table A3. Results of the assay sensitivity and efficiency test using the MIC thermal cycler.

Copies per µL	qPCR platform	
	MIC	
	Detection frequency	Assay properties
1.62×10^6	100%	**Efficiency:** 95.15% **R^2** : 0.996 **Y intercept**: 37.76 **Slope:** -3.443 **LOD**: 16.2 copies/µL **LOQ**: 16.2 copies/µL
1.62×10^5	100%	
1.82×10^4	100%	
1620	100%	
162	100%	
16.2	100%	
1.62	66.6%	
0.162	0%	

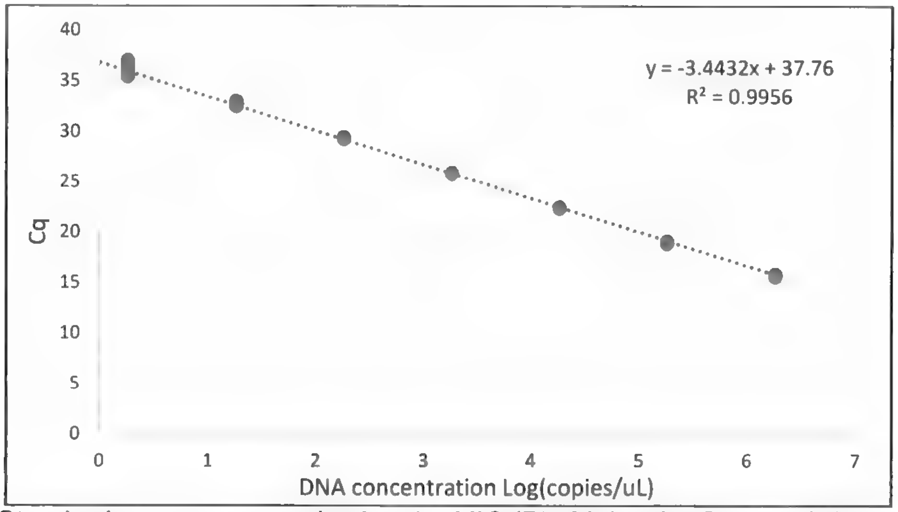

Figure A1: Standard curve generated using the MIC (Bio Molecular Systems) thermal cycler with 6 replicates per dilution.

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Supplementary material
The raw standard curve data and sequence alignment used for assay design are available upon request through Precision Biomonitoring Inc.

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Appendix ii: Burbot (*Lota lota*) TripleLock™ qPCR Assay Documentation

The Precision Biomonitoring TripleLock™ *Lota lota* qPCR assay for eDNA is a real-time PCR (qPCR) TaqMan assay, designed for the detection of burbot (*Lota lota*) environmental DNA (eDNA) from filtered water samples.

Technical specifications

The TripleLock™ *Lota lota* qPCR assay for eDNA is species-specific and contains proprietary formulation of primers, probes and master mix. The recommended qPCR cycling protocol is shown in Table B1.

Table B1. Recommended cycling protocol for the *L. lota* qPCR assay.

Step	Parameter
Initial Denature	2 min @ 95°C
Cycles	40
Denature	15 seconds @ 95°C
Anneal	45 seconds @ 60°C

General eDNA assay information

The TripleLock™ *L. lota* qPCR assay uses a 169 bp fragment from the *cytochrome c oxidase subunit I* (COI) mitochondrial marker to detect burbot in real time. The assay has been successfully Lab and field validated following the *Minimum Information for Publication of Quantitative Real-Time PCR Experiments* (MIQE) guidelines (Bustin *et al.* 2009). The validation includes testing specificity, sensitivity, and efficiency. Specificity was verified using DNA samples from the target species and from non-target species. Sensitivity and efficiency have been established by means of standard curves. Sensitivity is expressed as the limit of detection (LOD), which is the minimum DNA concentration that can be detected with 95% of confidence (Bustin *et al.* 2009). The limit of quantification (LOQ) the lowest concentration of target that can be accurately quantified with a coefficient of variance below a threshold of ≤35% obtained from calculated copy number from replicates in an assay specific standard curve (Forootan et al. 2017). The *L. lota* assay has a LOD= 1.01 copies/µL and LOQ = 1.01 copies/µL.

The *L. lota* assay has been validated using the MIC™ (Bio Molecular Systems) real-time cycler.

Assay specificity test

Specificity of the *L. lota* qPCR assay was tested using DNA samples from the target species (*L. lota*) and from three non-target species (Table B2).

Table B2. Species used in the specificity test of the *L. lota* qPCR assay

Species	Number of samples used	Detection with the standardized qPCR *L. lota* assay
Burbot *Lota lota* (target)	1	Yes
White sucker *Catostomus commersonii* (non-target)	1	No
Smallmouth bass *Micropterus dolomieu* (non-target)	1	No
Brook trout *Salvelinus fontinalis* (non-target)	1	No
No template control	1	No

Assay sensitivity and efficiency test

The validation of the *L. lota* assay was assessed with a standard curve performed in the MIC™ (Bio Molecular Systems) real-time cycler.

Table B3. Results of the assay sensitivity and efficiency test using the MIC™ real-time cycler.

Copies per µL	qPCR platform	
	MIC	
	Detection frequency	Assay properties
1.01×10^6	100%	**Efficiency:** 98% $\mathbf{R^2}$: 0.9966 **Y intercept**: 37.69 **Slope:** -3.369 **LOD:** 1.01 copies/µL **LOQ:** 1.01 copies/µL
1.01×10^5	100%	
1.01×10^4	100%	
1010	100%	
101	100%	
10.1	100%	
1.01	100%	
0.101	0%	

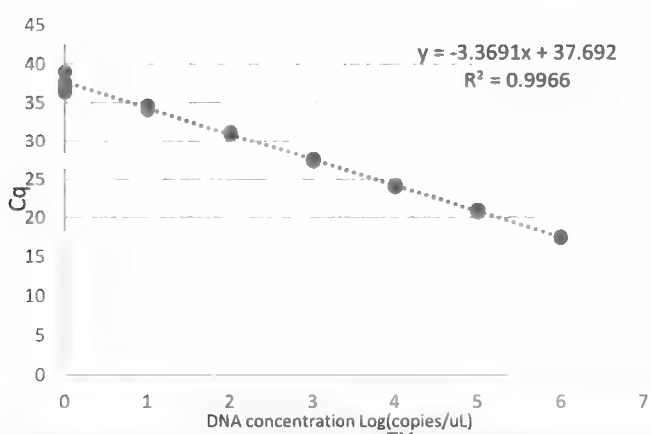

Figure B1: Standard curve generated using the MIC™ (Bio Molecular Systems) thermal cycler with 6 replicates per dilution.

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Supplementary material

The raw standard curve data and sequence alignment used for assay design are available upon request through Precision Biomonitoring Inc.

Precision Biomonitoring Inc.
5420 Hwy 6 N, Orchard Park Suite 226
Guelph, ON, N1H 6J2
(226) 486 - 3252

Appendix iii: Glossary

Base pairs (bp): a unit of measure for the length of a DNA fragment.

Biological replicate: replicates of samples taken from the same source material.

Cq: quantification cycle; the PCR cycle at which the target is considered positively amplified in a given sample.

Field blank: A sterile water sample that is filtered from a sterilized Nalgene bottle in the field to test for contamination that may occur during sampling or handling of samples. The field blank is transported alongside other samples during all stages of sampling.

External positive control: used to detect PCR inhibition in a reaction that may result from inhibitory substances carried through the sampling and extraction process.

Limit of detection (LOD): the lowest concentration of DNA that can be detected by a given qPCR assay 95% of the time, typically expressed as target copies/µL (Bustin *et al.* 2009).

Limit of quantification (LOQ): the lowest concentration of target that can be accurately quantified with a coefficient of variance below a threshold of ≤35% obtained from replicates in an assay specific standard curve (Forootan *et al.* 2017). Typically expressed as target copies/µL.

Negative control: A sample taken from a known negative site used to control for false positives that could result from allochthonous eDNA.

No template control (NTC): omits any DNA template from a reaction, and serves as a control for extraneous nucleic acid contamination.

Positive Amplification Control: used to verify that a qPCR assay is performing properly during analysis. Amplification controls consist of the target DNA and should always return a positive amplification with an expected Cq value for a given assay.

Quantitative Real-time PCR (qPCR): a highly sensitive polymerase chain reaction procedure which monitors the amplification and detection of a targeted DNA molecule in real time.

qPCR Assay: The collection of primers, hydrolysis probe, master mix, and cycling conditions on a specific thermal cycler designed and optimized to amplify and detect target DNA.

qPCR efficiency: determined from the slope of the log-linear portion of the standard curve. High qPCR efficiency is indicative of precise and robust qPCR assay performance.

TaqMan™: a type of qPCR assay which employs fluorescent DNA probes to increase specificity.

Target: Universal term for the nucleic acid sequence to be amplified.

Technical replicate: replicates used to perform the same test multiple times on a single sample.

Appendix iv: References

Bustin, S.A., Benes, V., Garson, J.A., Hellemans, J., Huggett, J., Kubista, M., Mueller, R., Nolan, T., Pfaffl, M.W., Shipley, G.L., Vandesompele, J., Wittwer, C.T., 2009. The MIQE Guidelines: Minimum Information for Publication of Quantitative Real-Time PCR Experiments. Clin. Chem. 55, 611–622. https://doi.org/10.1373/clinchem.2008.112797

Forootan, A., Sjöback, R., Björkman, J., Sjögreen, B., Linz, L., Kubista, M., 2017. Methods to determine limit of detection and limit of quantification in quantitative real-time PCR (qPCR). Biomol. Detect. Quantif. 12, 1–6. https://doi.org/10.1016/j.bdq.2017.04.001

PRECISION BIOMONITORING

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Your Project #: 2018-PN-1366
Cost Center Code# 300330.6060.105
Your C.O.C. #: OE-00588

Attention: HORIZON LAB

CNRL Horizon Main Laboratory
Horizon
P.O. Bag 4025
Fort McMurray, AB
CANADA T9H 3H5

Report Date: 2018/10/15
Report #: R2634648
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B888166
Received: 2018/10/10, 07:45

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbon (DOC) (1)	3	N/A	2018/10/14	EENVSOP-00060	MMCW 119 1996 m
Total Suspended Solids (NFR)	3	2018/10/11	2018/10/11	AB SOP-00061	SM 23 2540 D m

Remarks:

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Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.
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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) DOC present in the sample should be considered as non-purgeable DOC. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

Maxxam Analytics International Corporation o/a Maxxam Analytics Edmonton. 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Maxxam
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Your Project #: 2018-PN-1366
Cost Center Code# 300330.6060.105
Your C.O.C. #: OE-00588

Attention: HORIZON LAB

CNRL Horizon Main Laboratory
Horizon
P.O. Bag 4025
Fort McMurray, AB
CANADA T9H 3H5

Report Date: 2018/10/15
Report #: R2634648
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B888166
Received: 2018/10/10, 07:45

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Maxxam Job #: B888166
Report Date: 2018/10/15

CNRL Horizon Main Laboratory
Client Project #: 2018-PN-1366
Sampler Initials: NA

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		UM9935	UM9936	UM9937		
Sampling Date		2018/10/06 10:22	2018/10/06 10:41	2018/10/06 10:51		
COC Number		OE-00588	OE-00588	OE-00588		
	UNITS	EDNA 3/ 00-ENV-NR	EDNA 4/ 00-ENV-NR	EDNA 5/ 00-ENV-NR	RDL	QC Batch
Misc. Inorganics						
Dissolved Organic Carbon (C)	mg/L	17	18	16	0.50	9183453
Total Suspended Solids	mg/L	8.7	6.7	11	1.0	9179222
RDL = Reportable Detection Limit						

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Maxxam Job #: B888166
Report Date: 2018/10/15

CNRL Horizon Main Laboratory
Client Project #: 2018-PN-1366
Sampler Initials: NA

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	11.7°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9179222	Total Suspended Solids	2018/10/11	108	80 - 120	102	80 - 120	<1.0	mg/L	15	20
9183453	Dissolved Organic Carbon (C)	2018/10/14	119	80 - 120	90	80 - 120	<0.50	mg/L	NC	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Report Date: 2018/10/15

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Client Project #: 2018-PN-1366
Sampler Initials: NA

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Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

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Your Project #: 2018-PN-1366
Cost Center Code# 300330.6060.105
Your C.O.C. #: OE-00589

Attention: HORIZON LAB

CNRL Horizon Main Laboratory
Horizon
P.O. Bag 4025
Fort McMurray, AB
CANADA T9H 3H5

Report Date: 2018/10/18
Report #: R2636637
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B888518
Received: 2018/10/10, 12:34

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Tannin & Lignin (Total) (1)	1	N/A	2018/10/17	BBY6SOP-00023	SM-5550B m

Remarks:

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Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.
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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Maxxam Vancouver

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Success Through Sc

Your Project #: 2018-PN-1366
Cost Center Code# 300330.6060.105
Your C.O.C. #: OE-00589

Attention: HORIZON LAB

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Report Date: 2018/10/18
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CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B888518
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Maxxam Job #: B888518
Report Date: 2018/10/18

CNRL Horizon Main Laboratory
Client Project #: 2018-PN-1366

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		UN1872		
Sampling Date		2018/10/10 08:00		
COC Number		OE-00589		
	UNITS	HORIZON LAKE/00-ENV-NR	RDL	QC Batch
MISCELLANEOUS				
Tannins and Lignins	mg/L	0.92	0.10	9187767
RDL = Reportable Detection Limit				

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	10.0°C

Results relate only to the items tested.

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Maxxam Job #: B888518
Report Date: 2018/10/18

QUALITY ASSURANCE REPORT

CNRL Horizon Main Laboratory
Client Project #: 2018-PN-1366

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
9187767	Tannins and Lignins	2018/10/17	96	80 - 120	100	80 - 120	<0.10	mg/L	2.0	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

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Report Date: 2018/10/18

CNRL Horizon Main Laboratory
Client Project #: 2018-PN-1366

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Rob Reinert, B.Sc., Scientific Specialist

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HORZFCD - 00045 /6
Tab COC

Maxxam	CNRL Horizon, Main Laboratory, PO Bag 4025, Fort McMurray AB T9H 3H5 Ph: 780-824-2292 Fax: 780-828-3783	RUSH ANALYSIS? Require Report: Y/N Y X N	NO PAGE 1 OF 1

SHIPPED TO

Company:	Maxxam Analytics - Edmonton Environmental	Project Number:	2018-PN-1366
Attention:	Vlad Roujanski	Project Co-ordinator	Jeff Rose
Address:	9331-48 Street, Edmonton, AB, T6B 2R4	PO	Please refer to Project sheet
Phone:	780-577-7100	Client #	101-Enviro
		Quote#	

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Fax:		Phone/Fax:	[redacted]	DHL		
LIMS:	X	Mobile:		CNRL		
EMAIL:	X	EMAIL:	Horizon lab@CNRL.com horizonseniorstaff@maxxam.ca	OTHER	X	Delivered Via Maxxam Fort McMurray

Sample Information												Analysis Required (Please confirm with supplied project sheet)								
	OFFsite Job #	OFFsite Sample #	Container	Quantity	Horizon Sample #	Horizon Sample Point	Sample Description	Date & Time Sampled	Sampled By	Matrix	TAT	Tannin								
1	N/A	N/A	250mL Plastic	1	BW2166	00-ENV-NR	Horizon Lake	2018/10/10 @ 08:00	NA	LIQ	REG	X								

COMMENTS :	Please include the "Sample Description" and "Project Number" in final reports Refer to attached project sheet for more information.

Created By:	Jessica Zhao	Date/Time:	2018/10/10 @ 08:30	Received By.	[redacted]	Date/Time:	20181011 0600
Review By:	Craig Eddison [redacted]			Signature:	[redacted]		7,5,6 Kelbealy

ANALYTICAL REQUEST FORM COC # OE-00589

MAXXAM ANALYTICS HB812204
Sample BW2166-01R
ID . Horizon Lake
Sampling Date and Time : 2018/10/10 08:00 Containers :1
HSH P. HSHIP-ENVE

Received in McMurray
By: CJL
OCT 10 2018
@12:34pm
Temp: 10 10 11C °C

B888518

001692

Appendix A7

Fish Population Analyses

A7.0 FISH BIOMASS AND PRODUCTION MODELING

A7.1 ARCTIC GRAYLING

The Arctic grayling biomass and productivity modeling was conducted for the first time in 2018. Sufficient length-weight-age have been collected since 2015 to support the growth and productivity modeling. The assumption of consistent growth across the time period of 2015 to 2018 was required, because the length-weight-age data had to be pooled to provide a sufficient number of observations. These pooled growth data and age-length keys were then combined with the observed 2018 length distribution of Arctic grayling to calculate biomass and productivity.

Table A7.1 Summary of the Arctic grayling biomass and productivity model using length, weight, and age data combined with Von Bertalanffy growth modeling.

Age	Length-at-Age (mm; l_a)	Log_e Weight-at-Age (g)	Weight-at-Age (g; w_a)	Population Proportion at Age (μ_a)	Population at Age (Na)	Biomass at Age (kg)	Growth Rate at Age (Ga)	Production at Age (kg)
2	213	4.6	100	0.567	3,131	312	0.76	236
3	269	5.4	213	0.271	1,496	318	0.41	131
4	306	5.8	321	0.063	346	111	0.24	27
5	330	6.0	408	0.054	300	122	0.15	18
6	345	6.2	474	0.046	253	120	0.09	11

Table A7.2 Summary of the Von Bertalanffy growth model for Arctic grayling in Horizon Lake, 2015 to 2018.

Model Parameter	Description	Estimate
L_∞	Asymptotic length at which growth rate is zero	373 mm
K	Growth rate	0.43
a_0	Age at length 0	0.04

Figure A7.1 **Observed and modeled Arctic grayling length-at-age in Horizon Lake, 2015 to 2018.**

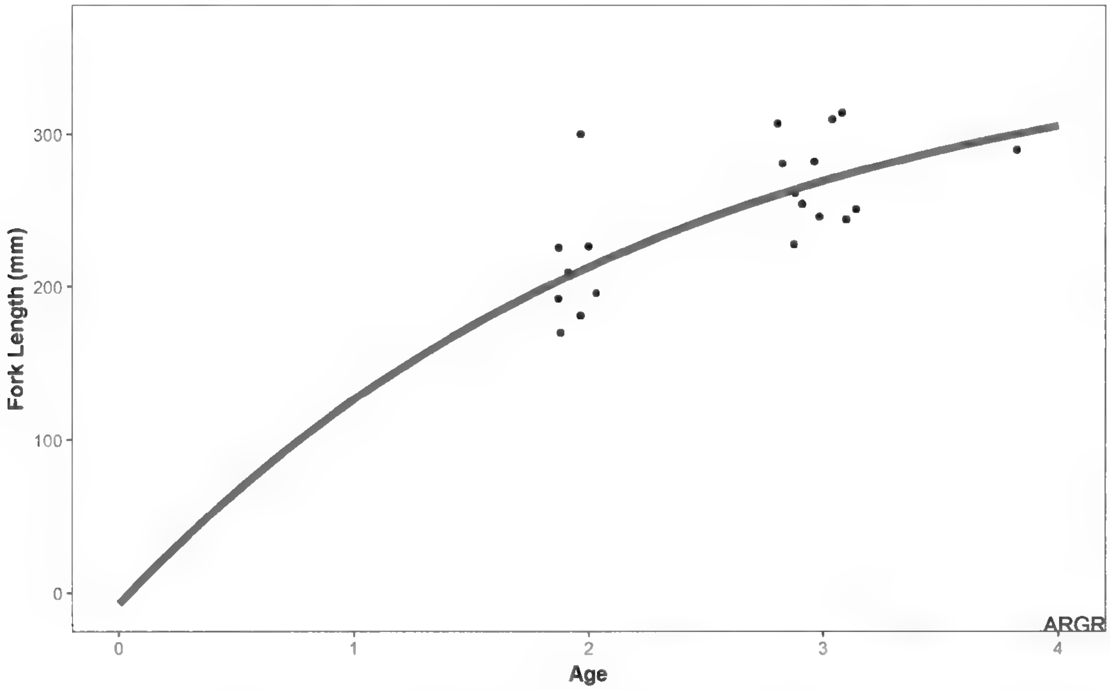
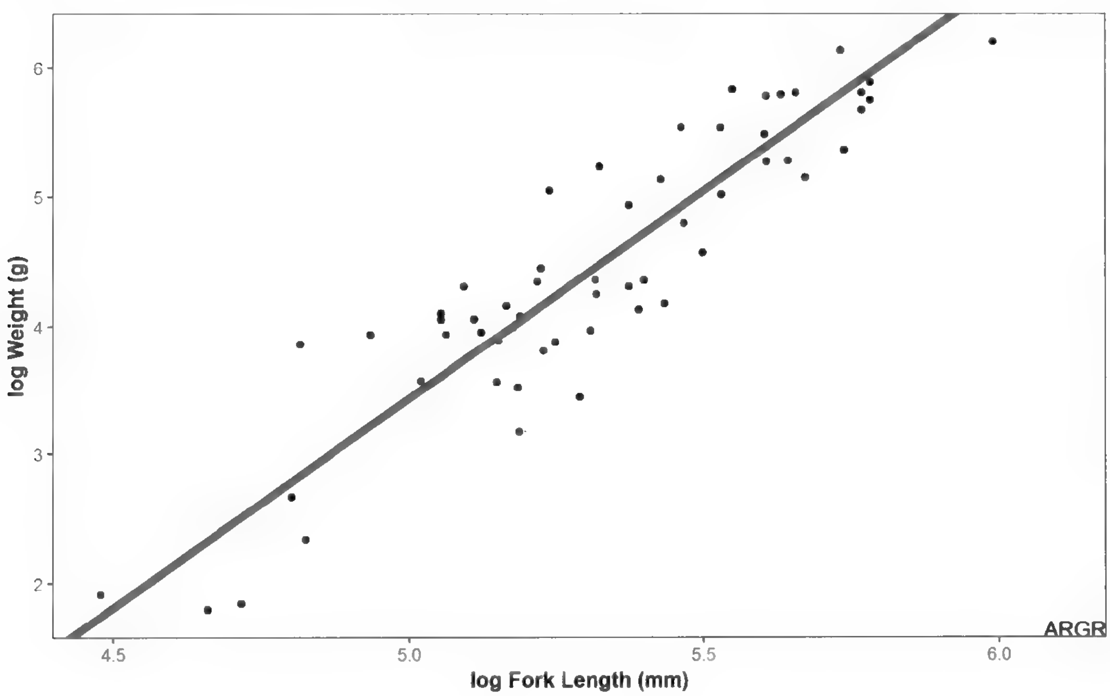


Figure A7.2 **Observed and modeled Arctic grayling length-weight relationship in Horizon Lake, 2015 to 2018.**



A7.2 WHITE SUCKER

Table A7.3 Summary of the white sucker biomass and productivity model using the observed 2018 length, weight, and age data combined with Von Bertalanffy growth modeling.

Age	Length-at-Age (mm; l_a)	Log_e Weight-at-Age (g)	Weight-at-Age (g; w_a)	Population Proportion at Age (μ_a)	Population at Age (Na)	Biomass at Age (kg)	Growth Rate at Age (Ga)	Production at Age (kg)
1	96	2.4	11	0.299	4,337	47	0.91	43
2	132	3.3	27	0.253	3,671	100	0.66	66
3	165	4.0	53	0.030	429	23	0.52	12
4	197	4.5	88	0.098	1,428	126	0.42	53
5	227	4.9	134	0.151	2,186	293	0.35	102
6	256	5.2	190	0.071	1,032	196	0.30	58
7	283	5.5	255	0.043	622	159	0.26	41
8	309	5.8	330	0.039	564	186	0.22	42
9	334	6.0	412	0.016	235	97	0.20	19

Table A7.4 Summary of the Von Bertalanffy growth model for white sucker in Horizon Lake, 2018.

Model Parameter	Description	Estimate
L_∞	Asymptotic length at which growth rate is zero	790 mm
K	Growth rate	0.052
a_0	Age at length 0	-1.5

Figure A7.3 **Observed and modeled white sucker length-at-age in Horizon Lake, 2018.**

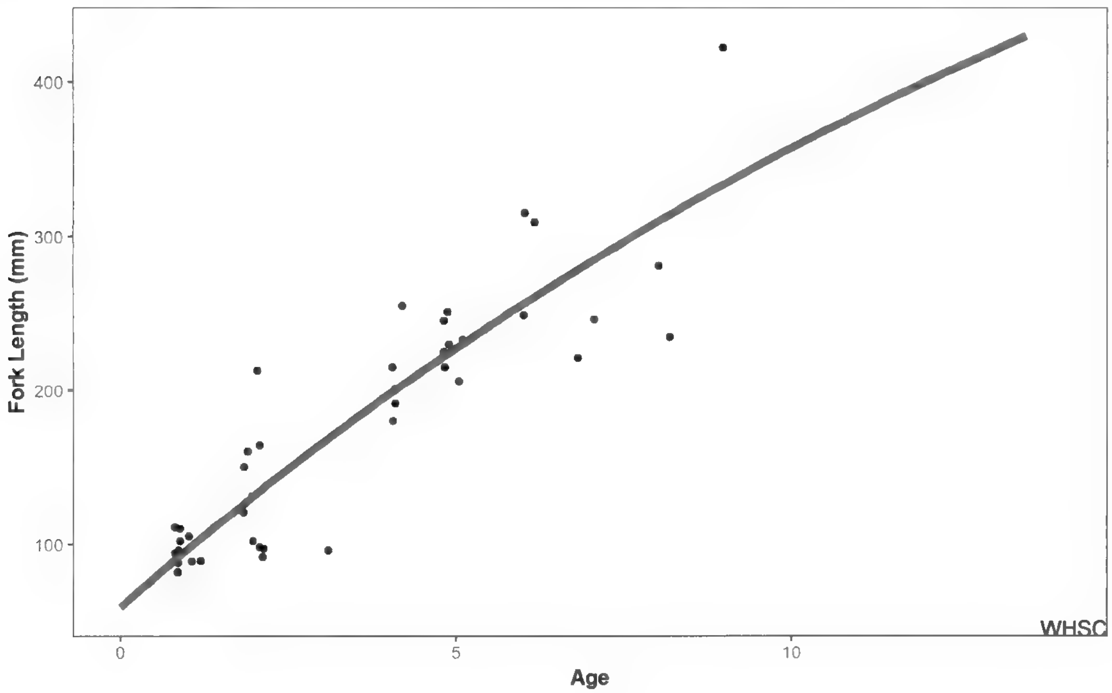
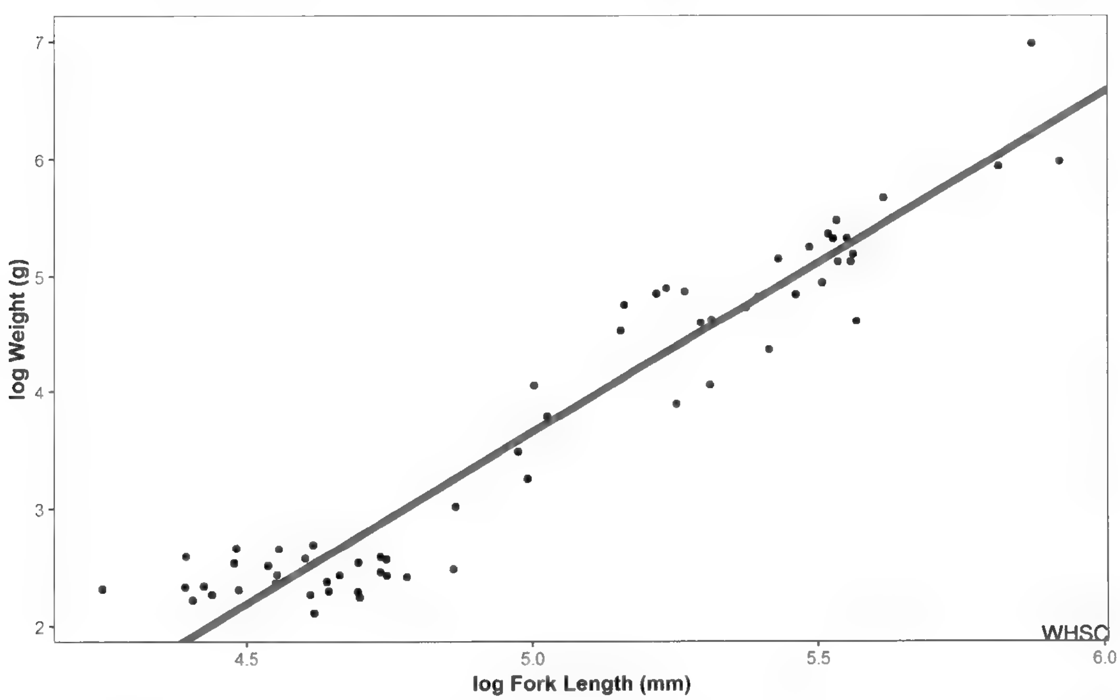


Figure A7.4 **Observed and modeled white sucker length-weight relationship in Horizon Lake, 2018.**



A7.3 LONGNOSE SUCKER

Limited 2018 length-weight-age data were available for the biomass and production modeling for longnose sucker. As a result, the 2017 length-weight-age data were used to generate the biomass-at-age, production-at-age, and age-length keys. These models were then combined with the 2018 longnose sucker abundance estimates to calculate production and biomass.

Table A7.5 Summary of the 2018 longnose sucker biomass and productivity model using the observed 2017 length, weight, and age data combined with Von Bertalanffy growth modeling.

Age	Length-at-Age (mm; l_a)	Log_e Weight-at-Age (g)	Weight-at-Age (g; w_a)	Population Proportion at Age (μ_a)	Population at Age (Na)	Biomass at Age (kg)	Growth Rate at Age (Ga)	Production at Age (kg)
0	67	1.5	4	0.027	12	0.1	1.94	0.10
1	135	3.4	31	0.120	55	1.7	0.90	1.5
2	185	4.3	75	0.192	88	6.6	0.53	3.5
3	224	4.8	126	0.117	54	6.8	0.34	2.3
4	252	5.2	177	0.079	36	6.4	0.23	1.5
5	274	5.4	223	0.030	14	3.1	0.16	0.50
6	290	5.6	263	0.175	80	21	0.12	2.5
7	303	5.7	295	0.128	59	17	0.08	1.5
8	312	5.8	321	0.118	54	17	0.06	1.1
9	319	5.8	342	0.014	7	2.3	0.05	0.10

Table A7.6 Summary of the Von Bertalanffy growth model for longnose sucker in Horizon Lake, 2017.

Model Parameter	Description	Estimate
L_∞	Asymptotic length at which growth rate is zero	341 mm
K	Growth rate	0.28
a_0	Age at length 0	-0.78

Figure A7.5 **Observed and modeled longnose sucker length-at-age in Horizon Lake, 2017.**

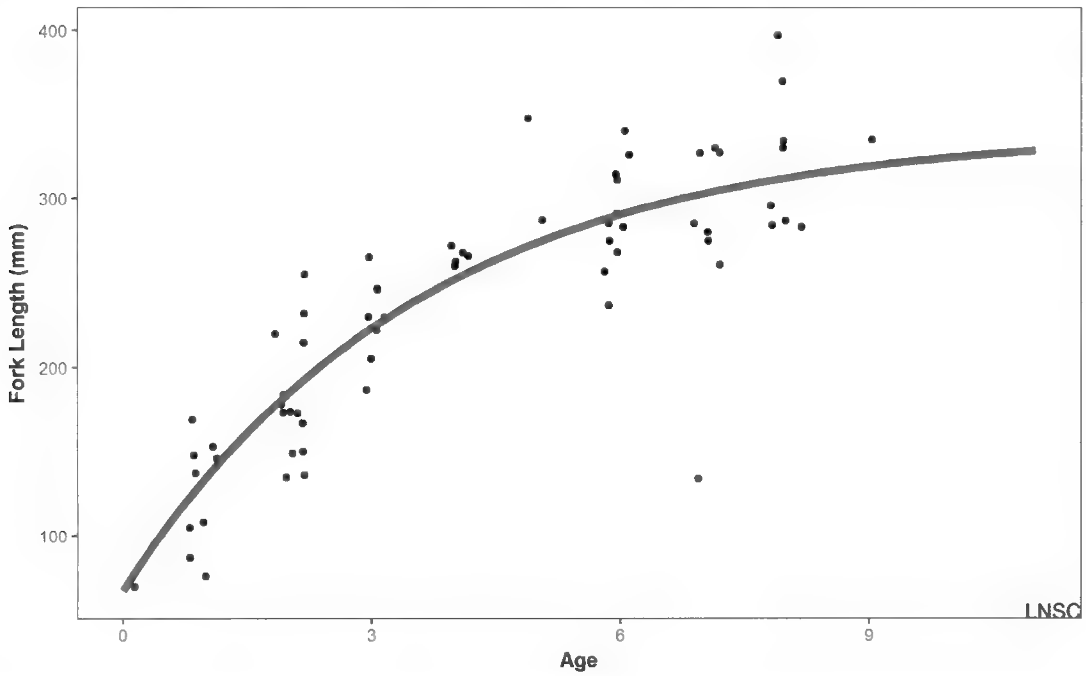
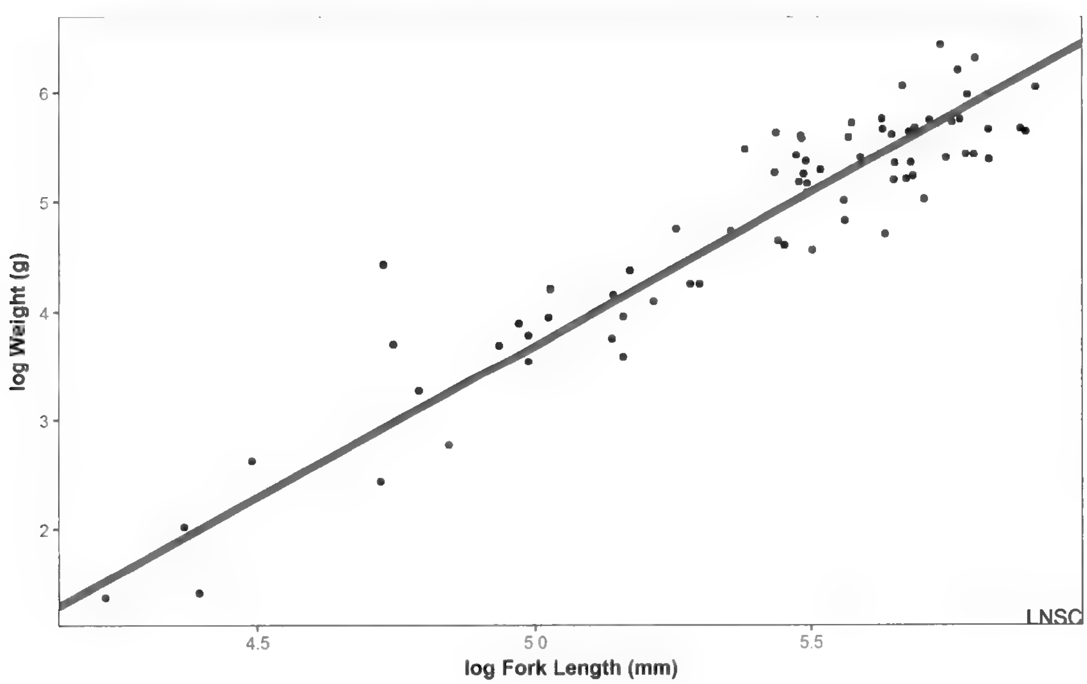


Figure A7.6 **Observed and modeled longnose sucker length-weight relationship in Horizon Lake, 2017.**



A7.4 LAKE CHUB

Limited 2018 length-weight-age data were available for the biomass and production modeling for lake chub. As a result, the 2017 length-weight-age data were used to generate the biomass-at-age, production-at-age, and age-length keys. These models were then combined with the 2018 lake chub abundance estimates to calculate production and biomass.

Table A7.7 Summary of the lake chub biomass and productivity model using the observed 2017 length, weight, and age data combined with Von Bertalanffy growth modeling.

Age	Length-at-Age (mm; l_a)	Log_e Weight-at-Age (g)	Weight-at-Age (g; w_a)	Population Proportion at Age (μ_a)	Population at Age (Na)	Biomass at Age (kg)	Growth Rate at Age (Ga)	Production at Age (kg)
0	59	0.9	2.4	0.073	1,589	3.8	0.98	3.8
1	82	1.9	6.4	0.477	10,443	67	0.59	39
2	99	2.4	11.5	0.247	5,411	62	0.39	24
3	113	2.8	17.0	0.090	1,971	33	0.27	8.9
4	123	3.1	22.1	0.112	2,459	54	0.17	9.1

Table A7.8 Summary of the Von Bertalanffy growth model for lake chub in Horizon Lake, 2017.

Model Parameter	Description	Estimate
L_∞	Asymptotic length at which growth rate is zero	158 mm
K	Growth rate	0.26
a_0	Age at length 0	-1.8

Figure A7.7 **Observed and modeled lake chub length-at-age in Horizon Lake, 2018.**

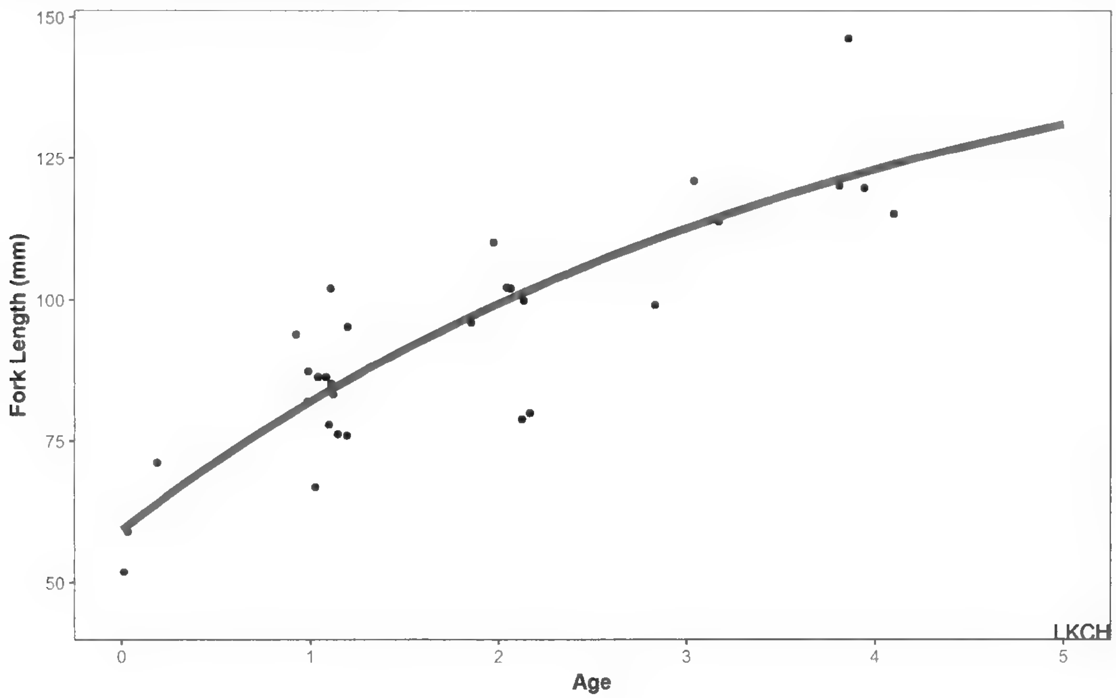
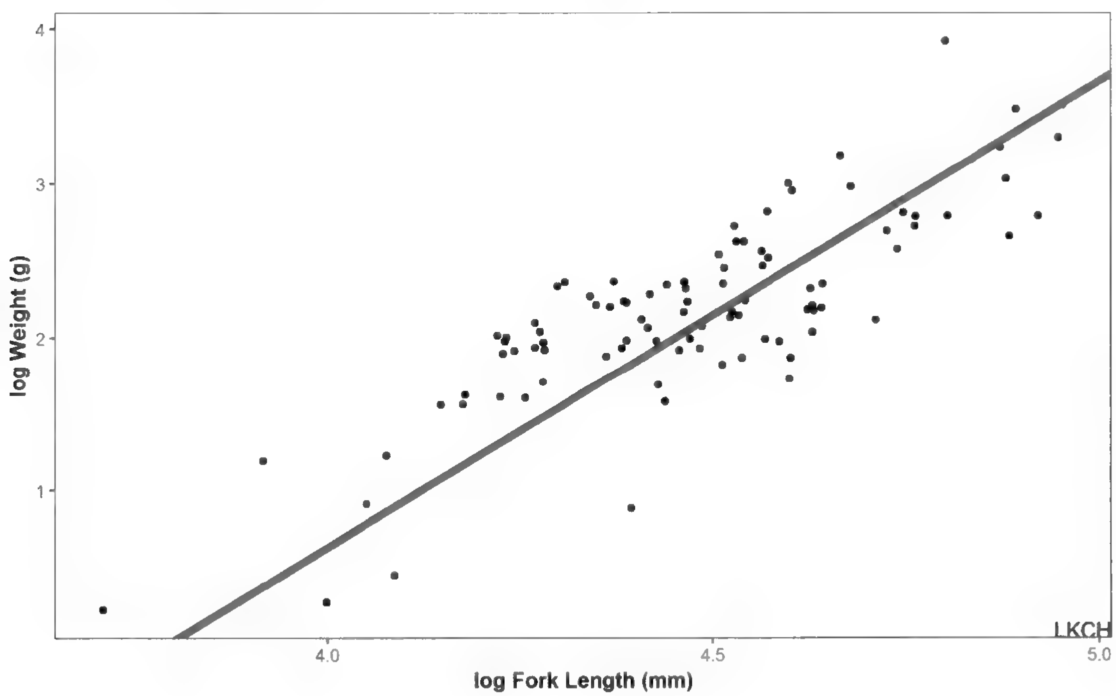


Figure A7.8 **Observed and modeled lake chub length-weight relationship in Horizon Lake, 2018.**



A7.5 FATHEAD MINNOW

The fathead minnow growth model was constructed using the 2018 length-weight-age and age-length keys; however, the Von Bertalanffy growth model could not be fitted to the available 2018 data. A linear model was used for growth, which was considered reasonable given that extrapolation beyond age 2 fish was not conducted.

Table A7.9 Summary of the fathead minnow biomass and productivity model using the observed 2018 length data combined with Von Bertalanffy growth modeling using fathead minnow data from 2018.

Age	Length-at-Age (mm; l_a)	Log_e Weight-at-Age (g)	Weight-at-Age (g; w_a)	Population Proportion at Age (μ_a)	Population at Age (Na)	Biomass at Age (kg)	Growth Rate at Age (Ga)	Production at Age (kg)
0	37	-0.7	0.5	0.076	4,980	2.5	1.06	2.7
1	51	0.4	1.5	0.337	22,214	32	0.80	26
2	66	1.2	3.2	0.587	38,657	125	0.64	80

Table A7.10 Summary of the linear growth model for fathead minnow in Horizon Lake, 2018.

Model Parameter	Description	Estimate
K	Growth rate (linear)	14.5
a_0	Length at age 0	37

Figure A7.9 Observed and modeled fathead minnow length-at-age in Horizon Lake, 2018.

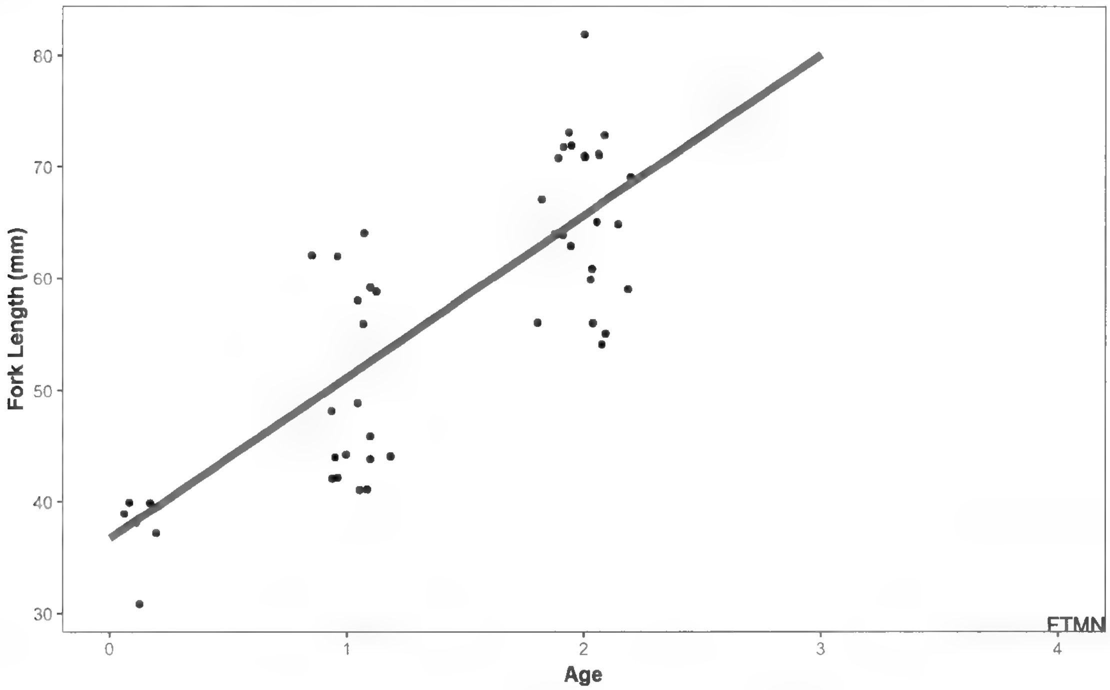
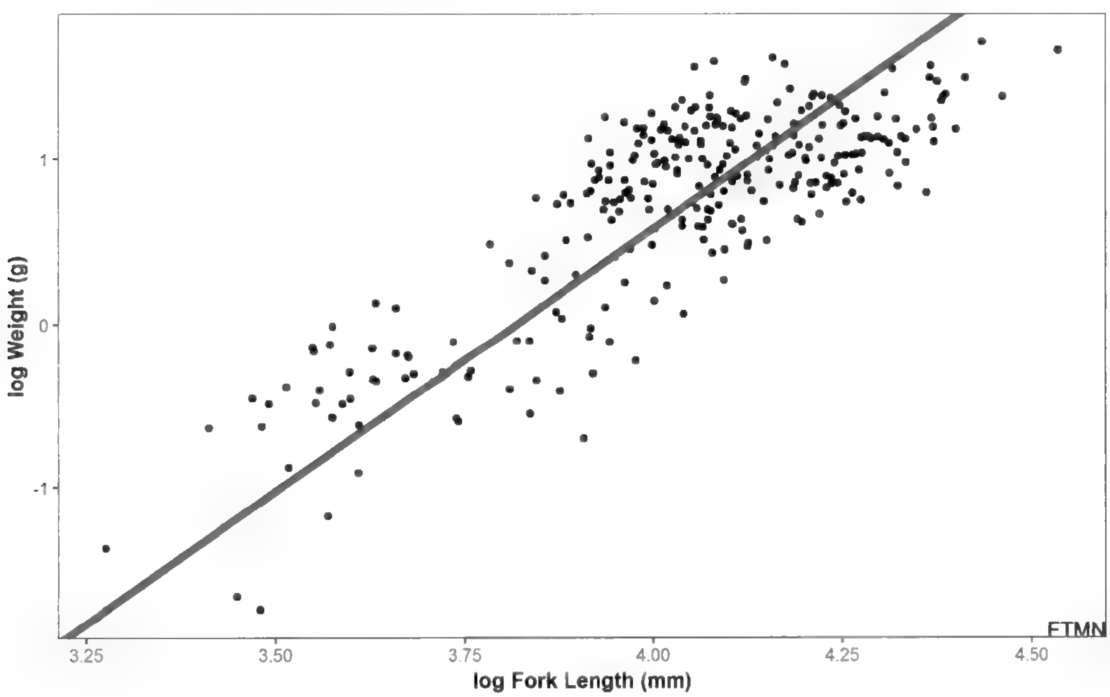


Figure A7.10 Observed and modeled fathead minnow length-weight relationship in Horizon Lake, 2018.



A7.6 FISH ABUNDANCE AND PRODUCTION ESTIMATES BASED ON HYDROACOUSTIC LENGTHS

The hydroacoustic survey provides information on the length distribution of fish in additional to estimates of their numbers. An alternative method of calculating fish species abundance was developed to incorporate the length information from the hydroacoustic survey into the abundance estimates, and potentially compensate for uncertainties caused by gear selectivity in the fish capture program. The method followed these steps:

1. The fish lengths measured by the hydroacoustic survey were binned to a series of size classes. The size classes used increments of 20 mm between 0 and 160 mm (e.g., 40 to 60 mm), increments of 40 mm between 160 and 400 mm, and 100 mm increments from 400 to 1,100 mm.
2. The relative abundance of fish in each size class was determined from the fish capture program, using the pooled fish capture information from 2017 and 2018. The pooling of fish capture data was necessary because of the low capture rates of LNSC in 2018.
3. The fish in each size class from the hydroacoustic survey were apportioned into species according to their relative abundances in the fish capture program.
4. The abundance estimates for each species were then calculated as the sum across the size classes, scaled from the hydroacoustic survey to the entire lake. This scaling was based on the scaling reported in the hydroacoustic report, which considered the length and depth of survey transects.

This alternative method made the following assumptions:

- Species-length distributions from the fish capture program were representative of the species-length distributions of fish observed in the hydroacoustic program.
- Fish of different sizes are distributed similarly throughout the hydroacoustic survey transects. This assumption was necessary because the hydroacoustic length data were not easily binned into the individual survey transects for scaling. As a result, the scaling applied in Step 4 was made across the survey, and therefore spatial variation is averaged within the species-length distributions.
- Fish lengths determined by the hydroacoustic survey had the same degree of uncertainty across all species and sizes.

Table A7.6-1 summarizes the results of the alternative hydroacoustic-based abundance, production, and biomass estimates. The abundance of longnose and white sucker increased using this method, because of the contribution of smaller suckers to the abundance of fish <150 mm in length. However, the abundance of Arctic grayling decreased, in part because smaller Arctic grayling have not been observed in Horizon Lake. Overall, the estimates of production and biomass were similar to the estimates from the established method.

Table A7.11 Fish species abundance, production, and biomass estimates based on hydroacoustic length observations.

Species	Abundance (S.D.)	Biomass (kg)	Production (kg/year)	P:B Ratio
ARGR	1,198 (71)	213	92	0.43
LKCH	26,082 (3,169)	264	101	0.38
FTMN	45,869 (9,616)	111	75	0.68
WHSC	22,083 (3,176)	1,868	662	0.35
LNSC	5,361 (501)	966	169	0.17
Total	**100,593**	**3,422**	**1,099**	**0.32**

Appendix A8

Quality Assurance & Quality Control (QA/QC)

A8.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance and quality control (QA/QC) is a documentation system used to review and audit data management and reporting activities. The objective of this system is to provide assurance that defined standards of quality are being achieved. Quality control refers to the specific methodological techniques that are implemented within the quality assurance plan. A successfully implemented QA/QC program will ensure that field and analytical methods are undertaken in a scientifically defensible and repeatable manner.

Hatfield maintains standard operating procedures (SOPs) for field data collection activities, to ensure standardized approaches are used by all Hatfield personnel. These documents identify specific methods for sample collection, sample labeling and handling, equipment calibration and use, and record-keeping. All Hatfield field technicians are familiar with the SOPs, and implement field programs according to the instructions presented within them. In advance of each sampling program, a set of field work instructions (FWI) was provided to and reviewed by each crew member. These documents consist of a detailed summary of the sampling tasks to be undertaken and the rationale for collecting the data. A pre-field meeting was held by the project manager before each sampling program to review the FWI. This approach allowed any discrepancies in understanding to be identified and addressed prior to data collections and ensured methodological continuity between field crews was attained.

A variety of quality control procedures were applied during field data collections and data handling for the 2018 Program, with the objective of providing incremental checks and balances throughout data collection, data analysis, and reporting; these methods are discussed in the QA/QC sections in the main body of this report.

Water Quality QA/QC

To assess potential contamination occurring in the field, samples of deionized water were prepared and submitted blind to the consulting laboratories for analysis alongside the ambient water samples. Laboratory prepared travel blanks were also submitted for each water quality program, to identify potential contamination issues related to laboratory handling and analysis.

Screening for potentially contaminated samples was achieved by comparing field blank results to analytical detection limits. Blanks with analyte concentrations below or near the detection limits represent samples that were collected and handled properly. Blanks with contaminant concentrations greater than five times the detection limits were identified as potentially contaminated during sample collection, shipping, or analysis.

A review of field and travel blank results was conducted to identify any variables that occurred at elevated levels, and to determine whether incidences of potential contamination resulted during sample collection (i.e., elevated concentrations in field blanks only), or during laboratory analysis (i.e., elevated concentrations in field and travel blanks, or travel blanks only).

Additionally, one set of split samples was collected from Horizon Lake during each sampling event and submitted blind to the laboratories. The purpose of collecting split samples is to measure within-site and analytical variability. Analytical results for split samples were compared, and the relative percent difference (RPD; difference between data values and average of data values multiplied by 100%) was calculated for each analyte. Relative percent differences greater than 20% were flagged as providing a potentially unacceptable level of precision; however, because precision decreases as the analyte concentration approaches the detection limit, relative percent differences greater than 20% were considered to be of

significance only if analyte concentrations in both samples were greater than five times the detection limit. The 20% RPD target for split samples is identical to QA thresholds used internally by contracted laboratories for most variables measured, although acceptable internal laboratory RPDs for some organic compounds (e.g., CCME hydrocarbons and some PAHs) may be higher (30 to 40%).

Dissolved and total mercury were identified as having potential contamination issues (i.e., analytes reported at greater than 5 times the method detection limit) in water quality field blank samples during the 2019 winter sampling event (Table A8.1); all analytes were less than 5 times the detection limit in fall 2018. The two split samples collected from Horizon Lake exhibited RPDs that were less than 20% for most conventional variables, major ions, nutrients, hydrocarbons, and metals (Table A8.2); however, fourteen analytes differed by greater than 20% when one or both concentrations were less than 5 times the detection limit, while five analytes (total dissolved solids, true colour, dissolved phosphorus, dissolved mercury, and total mercury) differed by greater than 20% and concentrations when both samples were more than 5 times the detection limit. All analytes with an RPD greater than 20% were below CCME (CCME 2011) and Government of Alberta (Government of Alberta 2018) guidelines for the protection of aquatic life, except for total phenols in fall 2018 and total mercury in winter 2019. Consequently, the RPD exceedances for these two analytes may be considered ecologically significant.

Table A8.1 Concentrations of water quality analytes in field blanks, September 2018 and February 2019.

Variable	Unit	6-Sep-18		21-Feb-19	
		Detection Limit	Field Blank	Detection Limit	Field Blank
Conventional Variables					
Conductivity	µS/cm	2	<2.0	2	<2.0
Dissolved Organic Carbon	mg/L	0.5	<0.50	0.5	<0.5
Hardness (as $CaCO_3$)	mg/L	0.5	<0.50	0.5	<0.5
pH	pH units	N/A	5.62	N/A	4.97
Total Alkalinity	mg/L	1	<1.0	1	<1
Total Dissolved Solids	mg/L	10	<10	10	<10
Total Organic Carbon	mg/L	0.5	<0.50	0.5	<0.5
Total Suspended Solids	mg/L	1	<1.0	1	<1
True Colour	T.C.U.	2	<2.0	2	<2
Major Ions					
Bicarbonate (HCO_3)	mg/L	1	<1.0	1	<1
Calcium (Ca)	mg/L	0.3	<0.30	0.3	<0.3
Carbonate (CO_3)	mg/L	1	<1.0	1	<1
Chloride (Cl)	mg/L	1	<1.0	1	<1
Hydroxide (OH)	mg/L	1	<1.0	1	<1
Hydrogen Sulphide (H_2S)	mg/L	0.002	<0.0020	0.002	<0.002
Magnesium (Mg)	mg/L	0.2	<0.20	0.2	<0.2
Potassium (K)	mg/L	0.3	<0.30	0.3	<0.3
Sodium (Na)	mg/L	0.5	<0.50	0.5	<0.5
Sulfate (SO_4)	mg/L	1	<1.0	1	<1
Total Sulphide (S_2)	mg/L	0.0019	<0.0019	0.0019	<0.0019
Nutrients and BOD					
Ammonia-N	mg/L	0.015	<0.015	0.015	<0.015
Biochemical Oxygen Demand	mg/L	2	<2.0	2	<2
Chlorophyll a	mg/L	0.0005	0.00098	0.5	<0.5
Nitrate	mg/L	0.01	<0.010	0.01	<0.01
Nitrate+Nitrite	mg/L	0.014	<0.014	0.014	<0.014
Nitrite	mg/L	0.01	<0.010	0.01	<0.01
Phosphorus, dissolved	mg/L	0.001	<0.0010	0.001	<0.001
Phosphorus, total	mg/L	0.001	<0.0010	0.001	<0.001
Total Kjeldahl Nitrogen	mg/L	0.05	<0.050	0.05	<0.05
Total Nitrogen	mg/L	0.055	<0.055	0.055	<0.055
Hydrocarbons					
Naphthenic Acids	mg/L	1	<1.0	1	<1
Total Phenols	mg/L	0.002	<0.0020	0.002	<0.002
Total Petroleum Hydrocarbon	mg/L	2	<2.0	2	<2
Dissolved Metals					
Aluminum (Al)	mg/L	0.003	<0.0030	0.003	<0.003
Antimony (Sb)	mg/L	0.0006	<0.00060	0.0006	<0.0006
Arsenic (As)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Barium (Ba)	mg/L	0.01	<0.010	0.01	<0.01
Beryllium (Be)	mg/L	0.001	<0.0010	0.001	<0.001
Boron (B)	mg/L	0.02	<0.020	0.02	<0.02
Cadmium (Cd)	mg/L	0.00002	<0.00002	0.00002	<0.00002
Chromium (Cr)	mg/L	0.001	<0.0010	0.001	<0.001
Cobalt (Co)	mg/L	0.0003	<0.00030	0.0003	<0.0003
Copper (Cu)	mg/L	0.0002	<0.00020	0.0002	0.00023
Iron (Fe)	mg/L	0.06	<0.060	0.06	<0.06
Lead (Pb)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Lithium (Li)	mg/L	0.02	<0.020	0.02	<0.02
Manganese (Mn)	mg/L	0.004	<0.0040	0.004	<0.004
Mercury (Hg)	ng/L	0.1	<0.10	0.1	3.3
Molybdenum (Mo)	mg/L	0.0002	<0.00020	0.0002	<0.0002

\# Indicates sample concentration is greater than five times the detection limit.

Table A8.1 (Cont'd.)

Variable	Unit	6-Sep-18		21-Feb-19	
		Detection Limit	Field Blank	Detection Limit	Field Blank
Dissolved metals (Cont'd.)					
Nickel (Ni)	mg/L	0.0005	<0.00050	0.0005	<0.0005
Phosphorous (P)	mg/L	0.1	<0.10	0.1	<0.1
Selenium (Se)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Silicon (Si)	mg/L	0.1	<0.10	0.1	<0.1
Silver (Ag)	mg/L	0.0001	<0.00010	0.0001	<0.0001
Strontium (Sr)	mg/L	0.02	<0.020	0.02	<0.02
Sulphur (S)	mg/L	0.2	<0.20	0.2	<0.2
Thallium (Tl)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Tin (Sn)	mg/L	0.001	<0.0010	0.001	<0.001
Titanium (Ti)	mg/L	0.001	<0.0010	0.001	<0.001
Uranium (U)	mg/L	0.0001	<0.00010	0.0001	<0.0001
Vanadium (V)	mg/L	0.001	<0.0010	0.001	<0.001
Zinc (Zn)	mg/L	0.003	<0.0030	0.003	<0.003
Total Metals					
Aluminum (Al)	mg/L	0.003	0.017	0.003	<0.003
Antimony (Sb)	mg/L	0.0006	<0.00060	0.0006	<0.0006
Arsenic (As)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Barium (Ba)	mg/L	0.01	<0.010	0.01	<0.01
Beryllium (Be)	mg/L	0.001	<0.0010	0.001	<0.001
Boron (B)	mg/L	0.02	<0.020	0.02	<0.02
Cadmium (Cd)	mg/L	0.00002	0.000022	0.00002	<0.00002
Calcium (Ca)	mg/L	0.3	<0.30	0.3	<0.3
Chromium (Cr)	mg/L	0.001	0.0015	0.001	<0.001
Cobalt (Co)	mg/L	0.0003	<0.00030	0.0003	<0.0003
Copper (Cu)	mg/L	0.0002	0.00025	0.0002	<0.0002
Iron (Fe)	mg/L	0.06	<0.060	0.06	<0.06
Lead (Pb)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Lithium (Li)	mg/L	0.02	<0.020	0.02	<0.02
Magnesium (Mg)	mg/L	0.2	<0.20	0.2	<0.2
Manganese (Mn)	mg/L	0.004	<0.0040	0.004	<0.004
Mercury (Hg)	ng/L	0.1	<0.10	0.1	2.7
Methyl mercury (CH_3Hg)	ng/L	0.08	<0.08	0	0
Molybdenum (Mo)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Nickel (Ni)	mg/L	0.0005	<0.00050	0.0005	<0.0005
Phosphorous (P)	mg/L	0.1	<0.10	0.1	<0.1
Potassium (K)	mg/L	0.3	<0.30	0.3	<0.3
Selenium (Se)	mg/L	0.0002	0.00025	0.0002	<0.0002
Silicon (Si)	mg/L	0.1	<0.10	0.1	<0.1
Silver (Ag)	mg/L	0.0001	<0.00010	0.0001	<0.0001
Sodium (Na)	mg/L	0.5	<0.50	0.5	<0.5
Strontium (Sr)	mg/L	0.02	<0.020	0.02	<0.02
Sulphur (S)	mg/L	0.2	<0.20	0.2	<0.2
Thallium (Tl)	mg/L	0.0002	<0.00020	0.0002	<0.0002
Tin (Sn)	mg/L	0.001	<0.0010	0.001	<0.001
Titanium (Ti)	mg/L	0.001	<0.0010	0.001	<0.001
Uranium (U)	mg/L	0.0001	<0.00010	0.0001	<0.0001
Vanadium (V)	mg/L	0.001	0.0015	0.001	<0.001
Zinc (Zn)	mg/L	0.003	<0.0030	0.003	<0.003

# Indicates sample concentration is greater than five times the detection limit.

Table A8.2 Relative percent difference between split water quality samples collected from Horizon Lake, September 2018 and February 2019.

Analyte	Unit	06-Sep-18 Detection Limit	06-Sep-18 HZL-Comp	06-Sep-18 HZL-Split	Relative Percent Difference (%)[1]	21-Feb-19 Detection Limit	21-Feb-19 HZL-Comp	21-Feb-19 HZL-Split	Relative Percent Difference (%)[1]
Conventional Variables									
Conductivity	µS/cm	2.0	240	240	0	2	310	300	3
Dissolved Organic Carbon	mg/L	0.5	17	18	5.7	2.5, 0.5	19	19	0
Hardness (as $CaCO_3$)	mg/L	0.5	110	110	0	0.5	140	130	7
pH	pH units	N/A	8.01	8.02	0.12	N/A	8.11	8	1
Total Alkalinity	mg/L	1.0	95	95	0	1	120	120	0
Total Dissolved Solids	mg/L	10	180	180	0	10	150	100	40
Total Organic Carbon	mg/L	0.5	18	17	5.7	0.5	15	14	7
Total Suspended Solids	mg/L	1.0	3.3	3.5	5.9	1	1	1.3	26
True Colour	T.C.U.	2.0	23	52	77	2	35	37	6
Major Ions									
Bicarbonate (HCO_3)	mg/L	1.0	120	120	0	1	150	140	7
Calcium (Ca)	mg/L	0.3	30	29	3.4	0.3	37	34	8
Carbonate (CO_3)	mg/L	1.0	<1.0	<1.0	0.0	1	<1	<1	0
Chloride (Cl)	mg/L	1.0	1.5	1.2	22	1	1.3	1.9	38
Hydrogen Sulphide (H_2S)	mg/L	0.002	<0.0020	<0.0020	0	0.002	<0.002	<0.002	0
Hydroxide (OH)	mg/L	1.0	<1.0	<1.0	0	1	<1	<1	0
Magnesium (Mg)	mg/L	0.2	8.3	8.1	2.4	0.2	11	11	0
Potassium (K)	mg/L	0.3	1.1	1.1	0	0.3	1.5	1.3	14
Sodium (Na)	mg/L	0.5	8.1	7.9	2.5	0.5	11	11	0
Sulfate (SO_4)	mg/L	1.0	27	27	0	1	34	33	3
Total Sulphide (S_2)	mg/L	0.0019	<0.0019	<0.0019	0	0.0019	<0.0019	<0.0019	0
Nutrients and BOD									
Ammonia-N	mg/L	0.015	0.033	0.02	49	0.0015	<0.015	<0.015	0
Biochemical Oxygen Demand	mg/L	2	4.3	4.5	4.5	2	<2	<2	0
Chlorophyll a	mg/L	0.0005	0.0180	0.0187	3.8	0.5	<0.5	<0.5	0
Nitrate	mg/L	0.01	<0.010	0.01	0	0.01	0.086	0.076	12
Nitrate+Nitrite	mg/L	0.014	0.020	0.034	52	0.014	0.086	0.076	12
Nitrite	mg/L	0.01	0.02	0.024	18	0.01	<0.01	<0.01	0
Phosphorus, dissolved	mg/L	0.001	0.0073	0.012	49	0.001	0.011	0.0086	24
Phosphorus, total	mg/L	0.001	0.053	0.05	5.8	0.001	0.014	0.014	0
Total Kjeldahl Nitrogen	mg/L	0.05	0.59	0.66	11	0.05	0.56	0.57	2
Total Nitrogen	mg/L	0.055	0.61	0.7	14	0.055	0.65	0.64	2

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

# (grey)	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
# (black)	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Table A8.2 (Cont'd.)

Analyte	Unit	06-Sep-18 Detection Limit	06-Sep-18 HZL-Comp	06-Sep-18 HZL-Split	Relative Percent Difference (%)[1]	21-Feb-19 Detection Limit	21-Feb-19 HZL-Comp	21-Feb-19 HZL-Split	Relative Percent Difference (%)[1]
Hydrocarbons									
Naphthenic Acids	mg/L	1	<1.0	<1.0	0	1	<1	<1	0
Total Phenols	mg/L	0.002	0.0065	0.005	26	0.002	0.004	0.0041	2
Total Petroleum Hydrocarbon	mg/L	2	<2.0	<2.0	0	2	<2	<2	0
Dissolved Metals									
Aluminum (Al)	mg/L	0.003	<0.0030	0.0054	57	0.003	0.0039	<0.003	26
Antimony (Sb)	mg/L	0.0006	<0.00060	<0.00060	0	0.0006	<0.0006	<0.0006	0
Arsenic (As)	mg/L	0.0002	0.0012	0.0013	8.0	0.0002	0.00052	0.00055	6
Barium (Ba)	mg/L	0.01	0.029	0.028	3.5	0.01	0.035	0.032	9
Beryllium (Be)	mg/L	0.001	<0.0010	<0.0010	0	0.001	<0.001	<0.001	0
Boron (B)	mg/L	0.02	0.047	0.048	2.1	0.02	0.058	0.06	3
Cadmium (Cd)	mg/L	0.00002	<0.00002	<0.00002	0	0.00002	<0.00002	<0.00002	0
Chromium (Cr)	mg/L	0.001	<0.0010	<0.0010	0	0.001	<0.001	<0.001	0
Cobalt (Co)	mg/L	0.0003	<0.00030	<0.00030	0	0.0003	<0.0003	<0.0003	0
Copper (Cu)	mg/L	0.0002	0.00056	0.00067	18	0.0002	0.00051	0.00078	42
Iron (Fe)	mg/L	0.06	<0.060	0.064	6.5	0.06	<0.06	<0.06	0
Lead (Pb)	mg/L	0.0002	<0.00020	<0.00020	0	0.0002	<0.0002	<0.0002	0
Lithium (Li)	mg/L	0.02	<0.020	<0.020	0	0.02	<0.02	<0.02	0
Manganese (Mn)	mg/L	0.004	<0.0040	<0.0040	0	0.004	0.012	0.013	8
Mercury (Hg)	ng/L	0.1	0.55	1.1	67	0.1	1.1	1.2	9
Molybdenum (Mo)	mg/L	0.0002	0.00097	0.0012	21	0.0002	0.0012	0.0011	9
Nickel (Ni)	mg/L	0.0005	0.0023	0.0029	23	0.0005	0.0027	0.0023	16
Phosphorous (P)	mg/L	0.1	<0.10	<0.10	0	0.1	<0.1	<0.1	0
Selenium (Se)	mg/L	0.0002	<0.00020	<0.00020	0	0.0002	<0.0002	<0.0002	0
Silicon (Si)	mg/L	0.1	1.8	1.8	0	0.1	0.6	0.62	3
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010	0	0.0001	<0.0001	<0.0001	0
Strontium (Sr)	mg/L	0.02	0.11	0.11	0	0.02	0.15	0.14	7
Sulphur (S)	mg/L	0.2	7.3	7.6	4.0	0.2	10	11	10
Thallium (Tl)	mg/L	0.0002	<0.00020	<0.00020	0	0.0002	<0.0002	<0.0002	0
Tin (Sn)	mg/L	0.001	<0.0010	<0.0010	0	0.001	<0.001	<0.001	0
Titanium (Ti)	mg/L	0.001	<0.0010	<0.0010	0	0.001	<0.001	<0.001	0
Uranium (U)	mg/L	0.0001	0.00023	0.00026	12	0.0001	0.00037	0.00057	43
Vanadium (V)	mg/L	0.001	<0.0010	<0.0010	0	0.001	<0.001	<0.001	0
Zinc (Zn)	mg/L	0.003	<0.0030	<0.0030	0	0.003	0.005	<0.003	50

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Table A8.2 (Cont'd.)

Analyte	Unit	06-Sep-18			Relative Percent Difference (%)[1]	21-Feb-19			Relative Percent Difference (%)[1]
		Detection Limit	HZL-Comp	HZL-Split		Detection Limit	HZL-Comp	HZL-Split	
Total Metals									
Aluminum (Al)	mg/L	0.003	0.051	0.051	0	0.003	0.022	0.022	0
Antimony (Sb)	mg/L	0.0006	<0.00060	<0.00060	0	0.0006	<0.0006	<0.0006	0
Arsenic (As)	mg/L	0.0002	0.0016	0.0015	6.5	0.0002	0.00073	0.00083	13
Barium (Ba)	mg/L	0.01	0.034	0.033	3.0	0.01	0.034	0.033	3
Beryllium (Be)	mg/L	0.001	<0.0010	<0.0010	0.0	0.001	<0.001	<0.001	0
Boron (B)	mg/L	0.02	0.051	0.051	0	0.02	0.056	0.054	4
Cadmium (Cd)	mg/L	0.00002	<0.00002	<0.00002	0.0	0.00002	<0.00002	<0.00002	0
Calcium (Ca)	mg/L	0.3	32	31	3.2	0.3	36	34	6
Chromium (Cr)	mg/L	0.001	0.0014	0.0017	19	0.001	<0.001	<0.001	0
Cobalt (Co)	mg/L	0.0003	<0.00030	<0.00030	0	0.0003	<0.0003	<0.0003	0
Copper (Cu)	mg/L	0.0002	0.0012	0.0012	0	0.0002	0.0011	0.0011	0
Iron (Fe)	mg/L	0.06	0.32	0.31	3.2	0.06	0.12	0.11	9
Lead (Pb)	mg/L	0.0002	<0.00020	<0.00020	0	0.0002	<0.0002	<0.0002	0
Lithium (Li)	mg/L	0.02	<0.020	<0.020	0	0.02	<0.02	<0.02	0
Magnesium (Mg)	mg/L	0.2	8.8	8.6	2.3	0.2	11	10	10
Manganese (Mn)	mg/L	0.004	0.1	0.099	1.0	0.004	0.017	0.017	0
Total Mercury	ng/L	0.1	0.42	1.2	96	0.1	6.4	0.91	150
Methyl Mercury	ng/L	0.08	<0.08	<0.08	0	0.03	<0.03	<0.03	0
Molybdenum (Mo)	mg/L	0.0002	0.0013	0.0013	0	0.0002	0.0014	0.0013	7
Nickel (Ni)	mg/L	0.0005	0.0026	0.0029	11	0.0005	0.0025	0.0028	11
Phosphorous (P)	mg/L	0.1	<0.10	<0.10	0	0.1	<0.1	<0.1	0
Potassium (K)	mg/L	0.3	1.3	1.3	0	0.3	1.4	1.4	0
Selenium (Se)	mg/L	0.0002	0.00028	0.00028	0	0.0002	<0.0002	<0.0002	0
Silicon (Si)	mg/L	0.1	2.3	2.2	4.4	0.1	0.63	0.61	3
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010	0	0.0001	<0.0001	<0.0001	0
Sodium (Na)	mg/L	0.5	8.9	8.6	3.4	0.5	11	10	10
Strontium (Sr)	mg/L	0.02	0.12	0.12	0	0.02	0.14	0.14	0
Sulphur (S)	mg/L	0.2	8	7.8	2.5	0.2	9.4	9.1	3
Thallium (Tl)	mg/L	0.0002	<0.00020	<0.00020	0	0.0002	<0.0002	<0.0002	0
Tin (Sn)	mg/L	0.001	<0.0010	<0.0010	0	0.001	<0.001	<0.001	0
Titanium (Ti)	mg/L	0.001	0.0025	<0.0010	0	0.001	0.0039	<0.001	118
Uranium (U)	mg/L	0.0001	0.00032	0.00025	25	0.0001	0.00041	0.00042	2
Vanadium (V)	mg/L	0.001	0.0021	0.002	4.9	0.001	<0.001	<0.001	0
Zinc (Zn)	mg/L	0.003	<0.0030	<0.0030	0	0.003	0.0033	0.0044	29

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

\# Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.

\# Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Sediment Quality QA/QC

One duplicate sample was taken from BEN-2 to assess laboratory precision. The RPDs of the analytes measured in the two samples were calculated, and those that exceeded 20% (when concentrations were greater than five times the detection limit in both samples) were considered to exhibit potentially unacceptable levels of precision.

The RPDs for most analytes measured in the duplicate sediment samples exceeded 20% (Table A8.3 and Table A8.4). A total of 19 analytes (15%) differed by more than 20% when one or both concentrations were less than 5 times the detection limit, while 102 analytes (80%) differed by more than 20% when both concentrations were more than 5 times the detection limit. All analytes with an RPD greater than 20% were below the CCME ISQG and PEL guidelines except for arsenic; however, arsenic has exceeded in all sediment samples collected in Horizon Lake since sampling began in 2009and consequently these RPD exceedances were not considered to be ecologically significant. Duplicate sediment analysis indicates that there is high within site variability. While duplicate samples are more suitable for characterizing within-site variation, split samples provide a more robust test of laboratory precision. The purpose of these QA/QC samples is to identify factors that may be affecting data integrity, such as cross-contamination, introduction of contaminants during sample collection and analysis, and analytical precision. As with water quality, the submission of blind split samples to the consulting laboratory would be expected to better quantify laboratory variability than duplicate sampling, and analysis will be recommended to replace the duplicate sample in future years.

Table A8.3 Relative percent difference (RPD) of conventional variables, hydrocarbons, volatiles, and metals in duplicate sediment samples, Horizon Lake, September 2018.

Analyte	Unit	Reportable Detection Limit		BEN-2	SSP-1 (Duplicate)	Relative Percent Difference (%)[1]
		BEN-2	SSP-1 (Duplicate)	5-Sep-18	5-Sep-18	
Conventional and Physical Variables						
Moisture	%	0.30	0.30	68	47	37
Total Organic Carbon (C)	%	0.05	0.05	2	0.2	164
Soluble (2:1) pH	pH	N/A	N/A	6.59	6.99	6
% sand by hydrometer	%	2.0	2.0	16	49	102
% silt by hydrometer	%	2.0	2.0	35	23	41
Clay Content	%	2.0	2.0	49	29	51
Texture	N/A	N/A	N/A	CLAY	SNDY CL LO	-
Hydrocarbons and Volatiles						
F1 (C6-C10) - BTEX	mg/kg	31	10	<31	<10	N/A
F1 (C6-C10)	mg/kg	31	10	<31	<10	N/A
F2 (C10-C16 Hydrocarbons)	mg/kg	31	10	<31	<10	N/A
F3 (C16-C34 Hydrocarbons)	mg/kg	160	50	170	89	63
F4 (C34-C50 Hydrocarbons)	mg/kg	160	50	<160	<50	N/A
Benzene	mg/kg	0.011	0.0050	<0.011	<0.005	N/A
Ethylbenzene	mg/kg	0.012	0.010	<0.012	<0.010	N/A
m & p-Xylene	mg/kg	0.15	0.040	<0.150	<0.040	N/A
o-Xylene	mg/kg	0.076	0.020	<0.076	<0.020	N/A
Toluene	mg/kg	0.076	0.020	<0.076	<0.020	N/A
Xylenes (Total)	mg/kg	0.17	0.045	<0.170	<0.045	N/A
Total Metals						
Total Aluminum (Al)	mg/kg	100	100	11800	9850	18
Total Antimony (Sb)	mg/kg	0.10	0.10	0.47	0.37	24
Total Arsenic (As)	mg/kg	0.50	0.50	12.6	9.7	26
Total Barium (Ba)	mg/kg	0.10	0.10	244	157	43
Total Beryllium (Be)	mg/kg	0.20	0.20	0.75	0.6	22
Total Bismuth (Bi)	mg/kg	0.10	0.10	0.26	0.15	54
Total Boron (B)	mg/kg	1.0	1.0	14.9	15.7	5
Total Cadmium (Cd)	mg/kg	0.050	0.050	0.399	0.249	46
Total Calcium (Ca)	mg/kg	100	100	5340	4360	20
Total Chromium (Cr)	mg/kg	1.0	1.0	25.5	20.2	23
Total Cobalt (Co)	mg/kg	0.30	0.30	11.7	9.82	17

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit.Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

N/A: not available; both concentrations were below detection limit and detection limit was different for both samples.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Table A8.3 (Cont'd.)

Analyte	Unit	Reportable Detection Limit		BEN-2	SSP-1 (Duplicate)	Relative Percent Difference (%)[1]
		BEN-2	SSP-1 (Duplicate)	5-Sep-18	5-Sep-18	
Total Metals (Cont'd.)						
Total Copper (Cu)	mg/kg	0.50	0.50	20.7	17.2	18
Total Iron (Fe)	mg/kg	100	100	29300	22600	26
Total Lead (Pb)	mg/kg	0.10	0.10	14.8	9.45	44
Total Lithium (Li)	mg/kg	5.0	5.0	17.6	16.7	5
Total Magnesium (Mg)	mg/kg	100	100	4140	3720	11
Total Manganese (Mn)	mg/kg	0.20	0.20	686	511	29
Total Mercury (Hg)	mg/kg	0.050	0.050	0.073	<0.050	37
Total Molybdenum (Mo)	mg/kg	0.10	0.10	1.29	0.77	50
Total Nickel (Ni)	mg/kg	0.80	0.80	27.6	22	23
Total Phosphorus (P)	mg/kg	10	10	1070	801	29
Total Potassium (K)	mg/kg	100	100	1970	1530	25
Total Selenium (Se)	mg/kg	0.50	0.50	0.82	<0.50	48
Total Silver (Ag)	mg/kg	0.050	0.050	0.122	0.075	48
Total Sodium (Na)	mg/kg	100	100	144	103	33
Total Strontium (Sr)	mg/kg	0.10	0.10	68.3	43.8	44
Total Thallium (Tl)	mg/kg	0.050	0.050	0.258	0.16	47
Total Tin (Sn)	mg/kg	0.10	0.10	0.62	0.5	21
Total Titanium (Ti)	mg/kg	1.0	1.0	30.2	46.4	42
Total Tungsten (W)	mg/kg	0.50	0.50	<0.50	<0.50	0
Total Uranium (U)	mg/kg	0.050	0.050	1.32	1.02	26
Total Vanadium (V)	mg/kg	2.0	2.0	37.6	34.8	8
Total Zinc (Zn)	mg/kg	1.0	1.0	92.8	69.8	28
Total Zirconium (Zr)	mg/kg	0.50	0.50	7.37	6.26	16

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit.Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

N/A: not available; both concentrations were below detection limit and detection limit was different for both samples.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Table A8.4 Relative percent difference (RPD) of organics concentrations in duplicate sediment samples, Horizon Lake, September 2018.

Analyte	Unit	Reportable Detection Limit		BEN-2	SSP-1 (Duplicate)	Relative Percent Difference (%)[1]
		BEN-2	SSP-1	5-Sep-18	5-Sep-18	
Naphthalene	ng/g	0.100	0.074	0.963	0.531	58
Acenaphthylene	ng/g	0.043	0.057	0.045	<0.057	24
Acenaphthene	ng/g	0.088	0.051	1.19	0.84	34
2-Methylfluorene	ng/g	0.087	0.072	0.435	0.262	50
C2 Phenanthrenes/Anthracenes	ng/g	0.043	0.073	20.5	14.5	34
Fluorene	ng/g	0.069	0.042	1.45	0.906	46
Phenanthrene	ng/g	0.069	0.046	3.57	2.41	39
Anthracene	ng/g	0.068	0.045	0.238	0.166	36
C1 Phenanthrenes/Anthracenes	ng/g	0.207	0.227	12.7	8.56	39
Fluoranthene	ng/g	0.103	0.157	2.52	1.79	34
Pyrene	ng/g	0.101	0.154	4.63	3.14	38
Benz[a]anthracene	ng/g	0.121	0.193	1.68	1.12	40
Chrysene	ng/g	0.128	0.209	8.69	6.06	36
Benzo[b]fluoranthene	ng/g	0.289	0.14	7.5	5.28	35
Benzo[j,k]fluoranthenes	ng/g	0.317	0.148	2.57	2.12	19
Benzo[e]pyrene	ng/g	0.389	0.184	7.42	5.12	37
Benzo[a]pyrene	ng/g	0.425	0.201	3.9	2.56	41
Perylene	ng/g	0.420	0.196	116	82.6	34
Dibenz[a,h]anthracene	ng/g	0.145	0.193	1.7	1.29	27
Indeno[1,2,3-cd]pyrene	ng/g	0.295	0.254	4.52	3.53	25
Benzo[ghi]perylene	ng/g	0.278	0.227	9.02	6.83	28
2-Methylnaphthalene	ng/g	0.073	0.048	1.28	0.805	46
1-Methylnaphthalene	ng/g	0.078	0.051	1.39	0.889	44
C1-Naphthalenes	ng/g	0.073	0.048	2.67	1.69	45
Biphenyl	ng/g	0.06	0.05	0.375	0.296	24
C1-Biphenyls	ng/g	0.049	0.032	0.705	0.579	20
C2-Biphenyls	ng/g	0.033	0.037	1.34	1.03	26
C2-Naphthalenes	ng/g	0.145	0.112	10	6.14	48
1,2-Dimethylnaphthalene	ng/g	0.145	0.112	0.515	0.187	93
2,6-Dimethylnaphthalene	ng/g	0.118	0.091	1.97	1.01	64
C3-Naphthalenes	ng/g	0.182	0.115	15.2	9.81	43
2,3,6-Trimethylnaphthalene	ng/g	0.176	0.111	3.86	2.53	42
2,3,5-Trimethylnaphthalene	ng/g	0.187	0.118	3.22	2.04	45
C4-Naphthalenes	ng/g	0.257	0.146	12.3	7.95	43
C1-Acenaphthenes	ng/g	0.058	0.041	0.156	0.134	15
C1-Fluorenes	ng/g	0.087	0.072	3.52	2.31	42
1,7-Dimethylfluorene	ng/g	0.187	0.185	0.652	0.525	22

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Table A8.4 (Cont'd.)

Analyte	Unit	Reportable Detection Limit		BEN-2	SSP-1 (Duplicate)	Relative Percent Difference (%)[1]
		BEN-2	SSP-1	5-Sep-18	5-Sep-18	
C2-Fluorenes	ng/g	0.187	0.185	11.8	7.69	42
C3-Fluorenes	ng/g	0.322	0.309	18.2	12.9	34
Dibenzothiophene	ng/g	0.09	0.11	1.13	0.767	38
C1-Dibenzothiophenes	ng/g	0.088	0.166	6.25	4.5	33
2/3-Methyldibenzothiophenes	ng/g	0.088	0.166	1.74	1.23	34
C2-Dibenzothiophenes	ng/g	0.137	0.205	23.1	17	30
2,4-Dimethyldibenzothiophene	ng/g	0.137	0.205	2.12	1.61	27
C3-Dibenzothiophenes	ng/g	0.248	0.163	32.6	26.6	20
C4-Dibenzothiophenes	ng/g	0.242	0.198	35.3	29	20
3-Methylphenanthrene	ng/g	0.209	0.229	2.35	1.56	40
2-Methylphenanthrene	ng/g	0.205	0.225	2.25	1.54	37
2-Methylanthracene	ng/g	0.214	0.235	0.312	0.238	27
9/4-Methylphenanthrene	ng/g	0.209	0.229	5.04	3.25	43
1-Methylphenanthrene	ng/g	0.207	0.227	2.79	1.97	34
3,6-Dimethylphenanthrene	ng/g	0.044	0.074	1.76	1.31	29
2,6-Dimethylphenanthrene	ng/g	0.043	0.073	1.31	0.846	43
1,7-Dimethylphenanthrene	ng/g	0.043	0.073	2.51	1.74	36
1,8-Dimethylphenanthrene	ng/g	0.043	0.073	0.817	0.66	21
C3-Phenanthrenes/Anthracenes	ng/g	0.169	0.316	21.8	16.1	30
1,2,6-Trimethylphenanthrene	ng/g	0.169	0.316	1.08	0.721	40
Retene	ng/g	0.869	0.95	14.9	10.5	35
C4-Phenanthrenes/Anthracenes	ng/g	0.869	0.95	93.1	68	31
C1-Fluoranthenes/Pyrenes	ng/g	0.264	0.297	22.4	16.2	32
3-Methylfluoranthene/Benzo[a]fluorene	ng/g	0.264	0.297	7.08	4.97	35
C2-Fluoranthenes/Pyrenes	ng/g	0.187	0.158	31.2	22.3	33
C3-Fluoranthenes/Pyrenes	ng/g	0.195	0.191	25.8	18.6	32
C4-Fluoranthenes/Pyrenes	ng/g	0.216	0.208	11	8.93	21
C1-Benzo[a]anthracenes/Chrysenes	ng/g	0.152	0.257	23.4	16.7	33
5/6-Methylchrysene	ng/g	0.153	0.26	2.05	1.53	29
1-Methylchrysene	ng/g	0.15	0.255	4.71	3.28	36
C2-Benzo[a]anthracenes/Chrysenes	ng/g	0.416	0.464	27.9	19.9	33
5,9-Dimethylchrysene	ng/g	0.416	0.464	7.55	5.56	30
C3-Benzo[a]anthracenes/Chrysenes	ng/g	0.213	0.146	7.86	5.59	34
C4-Benzo[a]anthracenes/Chrysenes	ng/g	0.24	0.197	4.1	2.93	33
C1-Benzofluoranthenes/Benzopyrenes	ng/g	0.294	0.273	41.7	32.6	24
7-Methylbenzo[a]pyrene	ng/g	0.294	0.273	1.57	1.14	32
C2-Benzofluoranthenes/Benzopyrenes	ng/g	0.399	0.646	12	8.99	29
1,4,6,7-Tetramethylnaphthalene	ng/g	0.257	0.146	1.68	1.13	39

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Benthic Invertebrate QA/QC

Taxonomic samples were sorted and identified by Dr. Jack Zloty of Summerland, BC. Laboratory methods included re-sorting a minimum of 5% of the total samples as a confirmation of the overall sorting efficiency. Sorted portions were verified by an independent analyst. A minimum removal efficiency of 90% was considered acceptable. Data were received in electronic format (Microsoft Excel©) from the taxonomist. All data were checked for transcription errors and other inconsistencies. Data analysis was conducted using duplicate data files for processing. Original data were retained in back-up files for the project.

A total of 45 samples were submitted for analysis in 2018. A re-sort was conducted on four of the benthic invertebrate samples (collected from BEN-1, 3, 5, and 9) to determine overall sorting efficiency, which confirmed a 97.6% removal rate (Table A8.3). This check conformed with the >95% re-sort efficiency expected for all benthic invertebrate samples collected.

Table A8.5 Benthic invertebrate sorting efficiency, 2018.

Sample ID	% sorting efficiency
BEN-1 A	[1-(2/(144+2))]*100 = 98.6
BEN-3 A	[1-(9/(383+9))]*100 = 97.7
BEN-5 C	[1-(5/(161+5))]*100 = 97.0
BEN-9 E	[1-(9/(307+9))]*100 = 97.1
	Average efficiency = 97.6%

% sorting efficiency = [1-(# in QA/AC re-sort / (# sorted originally + # QA/QC resort))]* 100

Phytoplankton and Zooplankton QA/QC

A Bray-Curtis similarity index was used to compare the similarity of the primary sample with the QA/QC sample. The Bray-Curtis similarity index was calculated as: $D1,2 = \sum qi$, where D1,2 is the similarity between samples 1 and 2 and qi is the smaller of the two relative abundances of species i. D can have a value ranging from 0%, indicating no similarity between the two samples, to 100%, indicating that both samples are identical. A Bray-Curtis similarity index of >60% indicates good agreement between the primary sample and QA/QC sample (Kelly 2001). The Bray-Curtis index for phytoplankton density (69%), phytoplankton biomass (69%), and zooplankton biomass (77%), were all greater than 60%, indicating good agreement between the two samples (Table A8.6 and A8.7). The Bray-Curtis index for zooplankton density was 45% (Table A45.7). The zooplankton community in Horizon Lake is highly diverse, with a maximum seasonal Simpson's Diversity of 0.27 observed in 2018. This may have resulted in the lower similarity between samples, because the similarity of samples is highly dependent upon species diversity, with higher diversity typically resulting in lower levels of similarity (Kelly 2001). Overall, zooplankton density and calculated metrics were within the range of historical results and the Bray-Curtis exceedance is not considered ecologically significant.

Table A8.6 Quality control results for phytoplankton density (#/L) and biomass (µg/m³) in Horizon Lake, 2018.

Species	Density (#/L)		Density (Percent Abundance)		Smaller abundance	Biomass (µg/m³)		Biomass (Percent Abundance)		Smaller abundance
	HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA		HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA	
DIATOMS										
Achnanthes minutissima Kuetzing	0	17,016	0	0.52	0	0	1	0	0.01	0
Asterionella formosa Hansall	0	17,016	0	0.52	0	0	6	0	0.05	0
Aulacoseira granulata var angustissima (O. Mulller) Simonsen	0	34,033	0	1.04	0	0	141	0	1.26	0
Aulacoseira distans (Ehrenberg) Simonsen	737,401	748,746	38	23	23	595	543	4	5	4
Aulacoseira granulata (Ehrenberg) Simonsen	124,791	850,848	6	26	6	2,591	722	18	6	6
Centric Diatom (6-12 um)- *(Stephanodiscus parvus* Stoermer & Hakansson)	11,344	0	0.58	0	0	4	0	0.03	0	0
Cymbella sp	0	0	0	0	0	0	0	0	0	0
Fragilaria crotonensis Kitton	0	0	0	0	0	0	0	0	0	0
Gyrosgima sp	0	0	0	0	0	0	0	0	0	0
Navicula sp	0	0	0	0.	0	0	0	0	0	0
Nitzschia acicularis (Kuetzing) W. Smith	0	17,016	0	0.52	0	0	2	0	0.02	0
Nitzschia sp	0	17,016	0	0.52	0	0	2	0	0.02	0
Rhizosolenia eriensis H.L. Smith	0	17,016	0	0.52	0	0	16	0	0.14	0
Rhizosolenia longiseta Ehrenberg	45,378	68,067	2.33	2.08	2.08	10	6	0.07	0.05	0.05
Stephanodiscus sp	0	0	0	0	0	0	0	0	0	0
Synedra sp	11,344	17,016	0.58	0.52	0.52	2	3	0.01	0.03	0.01
Synedra ulna (Nitzsch) Ehr.	0	0	0	0	0	0	0	0	0	0
CHLOROPHYCEAE										
Ankistrodesmus fusiformis Corda	0	0	0	0	0	0	0	0	0	0
Ankistrodesmus gracilis (Reinsch) Kors.	0	0	0	0	0	0	0	0	0	0
Ankyra lanceolata (Kors) Fott	0	0	0	0	0	0	0	0	0	0
Chlamydomonas globosa Snow	0	0	0	0	0	0	0	0	0	0
Coelastrum microporum Naegeli	0	0	0	0	0	0	0	0	0	0
Crucigenia quadrata Morren	0	0	0	0	0	0	0	0	0	0
Elakatothrix genevensis (Reverdin) Hindak	0	0	0	0	0	0	0	0	0	0
Monoraphidium braunii Naegeli	0	0	0	0	0	0	0	0	0	0
Monoraphidium dybowskii (Wolosz) Hindak et. Kom.-Legn.	0	0	0	0	0	0	0	0	0	·0

Table A8.6 (Cont'd.)

Species	Density (#/L)		Density (Percent Abundance)		Smaller abundance	Biomass (µg/m³)		Biomass (Percent Abundance)		Smaller abundance
	HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA		HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA	
CHLOROPHYCEAE (cont'd.)										
Monoraphidium griffithii (Berkeley) Komarkova-Legenerova	11,344	0	0.58	0	0	1	0	0.01	0	0
Monoraphidium minutum (Nag.) Komarkova-Legenerova	11,344	0	0.58	0	0	0	0	0	0	0
Monoraphidium setiforme (Nygaard) Komarkova-Legenerova	0	0	0	0	0	0	0	0	0	0
Oocystis borgei Snow	0	0	0	0	0	0	0	0	0	0
Oocystis parva W. & G.S. West	11,344	17,016	0.58	0.52	0.52	0	1	0	0.01	0
Scenesdesmus ecornis var. *bicellularis* (Ehrenberg) Chodat	0	17,016	0	0.52	0	0	0	0	0	0
Scenedesmus incrassatulus Bohlin	0	0	0	0	0	0	0	0	0	0
Scenedesmus opoliensis P.G. Richter	11,344	0	0.58	0	0	4	0	0.03	0	0
Scenedesmus arcuatus var. *platydisca* G. M. Smith	0	0	0	0	0	0	0	0	0	0
Tetraedron mimimum var. *tetralobulatum* Reins	0	0	0	0	0	0	0	0	0	0
Treubaria setigerum (Archer) G.M. Smith	11,344	0	0.58	0	0	3	0	0.02	0	0
Treubaria triappendiculata Bernard	0	0	0	0	0	0	0	0	0	0
CHRYSOPHYCEAE										
Chromulina sp.	0	0	0	0	0	0	0	0	0	0
Chromulina sp.	0	0	0	0	0	0	0	0	0	0
Dinobryon bavaricum Imhof	0	0	0	0	0	0	0	0	0	0
Dinobryon sp (loose monad)	0	0	0	0	0	0	0	0	0	0
Unidentified naked Chrysophyte sp (*Ochromonas/Chromulina*)-large	11,344	17,016	0.5[redacted]	0.52	0.52	4	6	0.03	0.05	0.03
Unidentified naked Chrysophyte sp (*Ochromonas/Chromulina*)-small	0	0	0	0	0	0	0	0	0	0
Haptophyte *(Erkenia/Chrysochromulina)*	0	0	0	0	0	0	0	0	0	0
Mallomomas caudata Iwanoff	0	34,033	0	1.04	0	0	173	0	1.55	0
Mallomonas sp	0	0	0	0	0	0	0	0	0	0
Pedinella sp	0	0	0	0	0	0	0	0	0	0
Spiniferomonas bourrellyi Takahashi	0	0	0	0	0	0	0	0	0	0
Uroglena sp	0	0	0	0	0	0	0	0	0	0

Table A8.6 (Cont'd.)

Species	Density (#/L)		Density (Percent Abundance)		Smaller abundance	Biomass (µg/m³)		Biomass (Percent Abundance)		Smaller abundance
	HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA		HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA	
CRYPTOPHYCEAE										
Cryptomonas erosa Ehrenberg	11,344	34,033	0.58	1.04	0.58	35	52	0.25	0.46	0.25
Cryptomonas marssonii Skuja	0	0	0	0	0	0	0	0	0	0
Cyrptomonas phaseolus Skuja	0	0	0	0	0	0	0	0	0	0
Cryptomonas pyrenoidifera Geitler	0	0	0	0	0	0	0	0	0	0
Cryptomonas reflexa Skuja	0	0	0	0	0	0	0	0	0	0
Katablepharis ovalis Skuja	0	17,016	0	0.52	0	0	2	0	0.02	0
Rhodomonas minuta Skuja	283,616	289,288	14.55	8.83	8.83	37	42	0.26	0.37	0.26
CYANOBACTERIA										
Anabaena affinis Lemmermann	0	0	0	0	0	0	0	0	0	0
Anabaena flos-aquae Brebisson	0	17,016	0	0.52	0	0	15	0	0.14	0
Anabaena mendotae Trelease	0	0	0	0	0	0	0	0	0	0
Anabaena solitaria Klebahn	0	0	0	0	0	0	0	0	0	0
Aphanocapsa delicatissima West & West	0	17,016	0	0.52	0	0	4	0	0.04	0
Aphanocapsa elachista W. & G.S. West	0	0	0	0	0	0	0	0	0	0
Aphanizomenon flos-aquae f. *gracile* (Lemmermann)	102,101	272,271	5.24	8.31	5.24	2,326	4,417	16.40	39.42	16.40
Aphanizomenon flos-aquae f. *gracile* (Lemmermann)	0	0	0	0	0	0	0	0	0	0
Aphanizomenon issatschenkoi (Usacev) Proskina-Lavrenko	0	0	0	0	0	0	0	0	0	0
Aphanothece sp	0	0	0	0	0	0	0	0	0	0
Chroococcus limneticus Lemmermann	0	0	0	0	0	0	0	0	0	0
Limnothrix sp	90,757	34,033	4.66	1.04	1.04	63	17	0.44	0.16	0.16
Planktothrix agardhii Gomont	0	0	0	0	0	0	0	0	0	0
Planktolyngbya contorta Lemmermann	0	0	0	0	0	0	0	0	0	0
Pseudanabaena limnetica Komarek	351,683	493,491	18.04	15.06	15.06	123	159	0.87	1.42	0.87
Romeria leopoliensis (Raciborski) Koczwara ex. Geitler	0	0	0	0	0	0	0	0	0	0
Synechocystis sp (bi-cell)-spherical	0	0	0	0	0	0	0	0	0	0

Table A8.6 (Cont'd.)

Species	Density (#/L)		Density (Percent Abundance)		Smaller abundance	Biomass (µg/m³)		Biomass (Percent Abundance)		Smaller abundance
	HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA		HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA	
EUGLENOPHYCEAE										
Trachelomonas dybowskii Dreseposlski	0	34,033	0	1.04	0	0	207	0	1.85	0
Trachemolomas volvocina Ehrenberg	56,723	85,084	2.91	2.60	2.60	173	260	1.22	2.32	1.22
DINOPHYCEAE										
Ceratium hirundinella (O.F. Muller) Schrank	54,454	78,278	2.79	2.39	2.39	8,212	4,368	57.89	38.98	38.98
Gymnodinium helveticum Pen.	0	17,016	0	0.52	0	0	39	0	0.35	0
TOTAL	**1,949,000**	**3,277,446**	**100**	**100**	**69**	**14,185**	**11,205**	**100**	**100**	**69**

Table A8.7 Quality control results for zooplankton abundance (organisms/m³) and biomass (micrograms/m³) in Horizon Lake, 2018.

Species	Density (#/L)		Density (Percent Abundance)		Smaller abundance	Biomass (µg/m³)		Biomass (Percent Abundance)		Smaller abundance
	HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA		HZL, Rep 1 (6-Sept-18)	QA	HZL, Rep 1 (6-Sept-18)	QA	
ROTIFERA										
Ascomorpha ovalis Bergendahl	0	0	0	0	0	0	0	0	0	0
Asplanchna brightwellei Gosse	115,409	130,247	5.74	16.05	5.74	845,782	954,525	39.94	54.07	39.94
Asplanchna sp	0	0	0	0	0	0	0	0	0	0
Collotheca mutabilis Harring	0	0	0	0	0	0	0	0	0	0
Conochilus unicornis Rousselet	0	16,281	0	2.01	0	0	11,867	0	0.67	0
Gastropus stylifer Imhof	65,948	0	3.28	0	0	48,069	0	2.27	0	0
Kellicotia longispina Kellicott	98,922	65,123	4.92	8.02	4.92	102,445	67,443	4.84	3.82	3.82
Keratella cochlearis Gosse	0	0	0	0	0	0	0	0	0	0
Notholca foliacea Ehrenberg	0	0	0	0	0	0	0	0	0	0
Polyathra dolicoptera Idelson	16,487	0	0.82	0	0	12,017	0	0.57	0	0
Polyathra major Burckhardt	148,383	48,843	7.38	6.02	6.02	160,166	52,721	7.56	2.99	2.99
Polyathra vulgaris Carlin	16,487	97,685	0.82	12.03	0.82	17,796	105,443	0.84	5.97	0.84
Synchaeta sp	0	16,281	0	2.01	0	0	29,064	0	1.65	0
Trichocerca multicrinis Kellicott	0	0	0	0	0	0	0	0	0	0
Vorticella sp	181,357	16,281	9.02	2.01	2.01	37,614	3,377	1.78	0.19	0.19
Calanoid nauplii	0	0	0	0	0	0	0	0	0	0
Cyclopoid (nauplii)	445,148	358,179	22.14	44.13	22.14	461,002	370,936	21.77	21.01	21.01
Opercularia sp	857,322	0	42.63	0	0	255,590	0	12.07	0	0
CALANOIDA	0	0	0	0	0	0	0	0	0	0
Diaptomus oregonensis Lilljeborg	2,652	3,536	0.13	0.44	0.13	27,847	37,130	1.32	2.10	1.32
Calanoid copepodid	884	0	0.04	0	0	1,463	0	0.07	0	0
CYCLOPOIDA	0	0	0	0	0	0	0	0	0	0
Cyclops bicuspidatus thomasi S. A. Forbes	15,913	13,261	0.79	1.63	0.79	89,826	74,855	4.24	4.24	4.24
Cyclopoid copepodid	24,754	25,638	1.23	3.16	1.23	35,779	37,057	1.69	2.10	1.69
CLADOCERA	0	0	0	0	0	0	0	0	0	0
Daphnia longiremis Sars	4,420	3,536	0.22	0.44	0.22	5,917	4,733	0.28	0.27	0.27
Bosmina longirostris O.F. Muller	14,145	14,145	0.70	1.74	0.70	7,571	7,571	0.36	0.43	0.36
Cladocera immature	0	0	0	0	0	0	0	0	0	0
Leptodora kindti Focke	0	0	0	0	0	0	0	0	0	0
Diaphanososma	2,652	2,652	0.13	0.33	0.13	8,624	8,624	0.41	0.49	0.41
TOTAL	**2,010,881**	**811,688**	**100**	**100**	**45**	**2,117,509**	**1,765,347**	**100**	**100**	**77**

Fish Populations

Quality control re-checks were conducted on 22 of the 180 fish ageing structures submitted for analysis in 2018 (Table A8.8). All re-checks were completed by a second technician without knowledge of the first result; the same age was reported for 20 (91%) of the 22 QA samples. The remaining two QA samples differed by one year.

Otoliths and fin rays were submitted from two fish in 2018. The age of both fish was reported as 7 years old based on otoliths and 5 years old based on fin rays.

One duplicate fish tissue sample was collected in October 2018. The RPD between the duplicate and primary sample was greater than 20% with one or both concentrations less than 5 times the detection limit for two analytes (arsenic and methyl mercury) and the difference between the two samples was greater than 20% with both concentrations greater than 5 times the detection limit for one analyte (strontium) (Table A8.9 and Table A8.10). The concentration of strontium was below the Region III USEPA (USEPA 2018) guideline for human health consumption; there are no Health Canada or National USEPA guidelines for human health consumption and no thresholds for evaluating potential risk to fish health. Consequently, the RPD exceedance for this analyte is not considered to be ecologically significant.

Table A8.8 Quality control results for fish ageing data, Horizon Lake, October 2018.

Location	Date	Structures	Species	Fish ID	Age	QA/QC
					KA	ML
TAR River Upper	23-May-18	FR	WHSC	206	6	6
TAR River Upper	23-May-18	FR	LNSC	207	7	7
TAR River Upper	23-May-18	FR	LNSC	208	8	7
TAR River Upper	23-May-18	FR	LNSC	209	6	6
Calumet River	2-Oct-18	FR	WHSC	142	1	1
Calumet River	2-Oct-18	FR	WHSC	143	1	1
S8	4-Oct-18	FR	FTMN	22	1	1
S8	4-Oct-18	FR	FTMN	23	2	2
S8	4-Oct-18	FR	FTMN	24	1	1
S8	4-Oct-18	FR	FTMN	25	1	1
I13	4-Oct-18	FR	LKCH	40	1	1
S4	5-Oct-18	FR	LKCH	154	1	1
D5	5-Oct-18	FR	LKCH	186	4	4
D8	6-Oct-18	FR	LKCH	204	1	1
I5	4-Oct-18	FR	WHSC	36	2	2
I5	4-Oct-18	FR	WHSC	37	5	5
I13	4-Oct-18	FR	WHSC	38	6	6
I13	4-Oct-18	FR	WHSC	39	4	4
I23	5-Oct-18	FR	WHSC	176	4	5
D5	5-Oct-18	FR	WHSC	187	4	4
I6	5-Oct-18	FR	WHSC	191	1	1
I6	5-Oct-18	FR	WHSC	192	3	3

Table A8.9 Relative percent difference of metals concentrations in duplicate fish tissue samples, Horizon Lake, October 2018.

Analyte	Units	Detection Limit	WHSC-351	Duplicate	Relative Percent Difference (%)[1]
Metals					
Aluminum (Al)-Total	mg/kg wwt	0.4	<0.4	<0.4	0
Antimony (Sb)-Total	mg/kg wwt	0.002	<0.002	<0.002	0
Arsenic (As)-Total	mg/kg wwt	0.004	0.0196	0.0158	21
Barium (Ba)-Total	mg/kg wwt	0.01	0.062	0.063	1.6
Beryllium (Be)-Total	mg/kg wwt	0.002	<0.002	<0.002	0
Bismuth (Bi)-Total	mg/kg wwt	0.002	<0.002	<0.002	0
Boron (B)-Total	mg/kg wwt	0.2	<0.2	<0.2	0
Cadmium (Cd)-Total	mg/kg wwt	0.001	<0.001	<0.001	0
Calcium (Ca)-Total	mg/kg wwt	4	204	242	17
Cesium (Cs)-Total	mg/kg wwt	0.001	0.0036	0.0037	2.7
Chromium (Cr)-Total	mg/kg wwt	0.01	0.067	0.061	9.4
Cobalt (Co)-Total	mg/kg wwt	0.004	0.0055	0.005	9.5
Copper (Cu)-Total	mg/kg wwt	0.02	0.412	0.377	8.9
Iron (Fe)-Total	mg/kg wwt	0.6	6.58	6.02	8.9
Lead (Pb)-Total	mg/kg wwt	0.004	<0.004	<0.004	0
Lithium (Li)-Total	mg/kg wwt	0.1	<0.1	<0.1	0
Magnesium (Mg)-Total	mg/kg wwt	0.4	275	278	1.1
Manganese (Mn)-Total	mg/kg wwt	0.01	0.206	0.226	9.3
Mercury (Hg)-Total	mg/kg wwt	0.006	0.12	0.117	3
Methyl mercury (CH_3Hg)	mg/kg wwt	0.016	0.0797	0.0599	28
Molybdenum (Mo)-Total	mg/kg wwt	0.004	0.0087	0.0074	16
Nickel (Ni)-Total	mg/kg wwt	0.04	0.043	<0.04	7.2
Phosphorus (P)-Total	mg/kg wwt	2	2350	2360	0.42
Potassium (K)-Total	mg/kg wwt	4	4180	4130	1.2
Rubidium (Rb)-Total	mg/kg wwt	0.01	1.47	1.49	1.4
Selenium (Se)-Total	mg/kg wwt	0.01	0.303	0.303	0
Silver (Ag)-Total	mg/kg wwt	0.001	<0.001	<0.001	0
Sodium (Na)-Total	mg/kg wwt	4	278	274	1.4
Strontium (Sr)-Total	mg/kg wwt	0.01	0.133	0.165	21
Tellurium (Te)-Total	mg/kg wwt	0.004	<0.004	<0.004	0
Thallium (Tl)-Total	mg/kg wwt	0.0004	<0.0004	<0.0004	0
Thorium (Th)-Total	mg/kg wwt	0.006	<0.006	<0.006	0
Tin (Sn)-Total	mg/kg wwt	0.02	<0.02	<0.02	0
Titanium (Ti)-Total	mg/kg wwt	0.02	0.024	0.033	32
Uranium (U)-Total	mg/kg wwt	0.0004	<0.0004	<0.0004	0
Vanadium (V)-Total	mg/kg wwt	0.02	<0.02	<0.02	0
Zinc (Zn)-Total	mg/kg wwt	0.1	3.53	3.34	5.5
Zirconium (Zr)-Total	mg/kg wwt	0.04	<0.04	<0.04	0

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Table A8.10 Relative percent difference of organics concentrations in duplicate fish tissue samples, Horizon Lake, October 2018.

Analyte	Units	Detection Limit	WHSC-351	Duplicate	Relative Percent Difference (%)[1]
1,1,1,2-Tetrachloroethane	mg/kg wwt	0.01	<0.01	<0.01	0
1,1,1-Trichloroethane	mg/kg wwt	0.01	<0.01	<0.01	0
1,1,2,2-Tetrachloroethane	mg/kg wwt	0.05	<0.05	<0.05	0
1,1,2-Trichloroethane	mg/kg wwt	0.01	<0.01	<0.01	0
1,1-Dichloroethane	mg/kg wwt	0.01	<0.01	<0.01	0
1,1-Dichloroethene	mg/kg wwt	0.01	<0.01	<0.01	0
1,1-Dichloropropene	mg/kg wwt	0.01	<0.01	<0.01	0
1,2,3-Trichlorobenzene	mg/kg wwt	0.01	<0.01	<0.01	0
1,2,3-Trichloropropane	mg/kg wwt	0.02	<0.02	<0.02	0
1,2,4-Trichlorobenzene	mg/kg wwt	0.01	<0.01	<0.01	0
1,2,4-Trimethylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
1,2-Dibromo-3-chloropropane	mg/kg wwt	0.01	<0.01	<0.01	0
1,2-Dibromoethane	mg/kg wwt	0.01	<0.01	<0.01	0
1,2-Dichlorobenzene	mg/kg wwt	0.01	<0.01	<0.01	0
1,2-Dichloroethane	mg/kg wwt	0.01	<0.01	<0.01	0
1,2-Dichloropropane	mg/kg wwt	0.01	<0.01	<0.01	0
1,3,5-Trimethylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
1,3-Dichlorobenzene	mg/kg wwt	0.01	<0.01	<0.01	0
1,3-Dichloropropane	mg/kg wwt	0.01	<0.01	<0.01	0
1,4-Dichlorobenzene	mg/kg wwt	0.01	<0.01	<0.01	0
2,2-Dichloropropane	mg/kg wwt	0.01	<0.01	<0.01	0
2-Chlorotoluene	mg/kg wwt	0.01	<0.01	<0.01	0
4-Chlorotoluene	mg/kg wwt	0.01	<0.01	<0.01	0
Benzene	mg/kg wwt	0.01	<0.01	<0.01	0
Bromobenzene	mg/kg wwt	0.01	<0.01	<0.01	0
Bromochloromethane	mg/kg wwt	0.01	<0.01	<0.01	0
Bromodichloromethane	mg/kg wwt	0.01	<0.01	<0.01	0
Bromoform	mg/kg wwt	0.01	<0.01	<0.01	0
Bromomethane	mg/kg wwt	0.1	<0.1	<0.1	0
Carbon tetrachloride	mg/kg wwt	0.01	<0.01	<0.01	0
Chlorobenzene	mg/kg wwt	0.01	<0.01	<0.01	0
Chloroethane	mg/kg wwt	0.1	<0.1	<0.1	0
Chloroform	mg/kg wwt	0.01	<0.01	<0.01	0
Chloromethane	mg/kg wwt	0.1	<0.1	<0.1	0
cis-1,2-Dichloroethene	mg/kg wwt	0.01	<0.01	<0.01	0
cis-1,3-Dichloropropene	mg/kg wwt	0.01	<0.01	<0.01	0
Dibromochloromethane	mg/kg wwt	0.01	<0.01	<0.01	0
Dibromomethane	mg/kg wwt	0.01	<0.01	<0.01	0

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Table A8.10 (Cont'd.)

Analyte	Units	Detection Limit	WHSC-351	Duplicate	Relative Percent Difference (%)[1]
Dichlorodifluoromethane	mg/kg wwt	0.01	<0.01	<0.01	0
Ethylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
Hexachlorobutadiene	mg/kg wwt	0.01	<0.01	<0.01	0
Isopropylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
m+p-Xylenes	mg/kg wwt	0.01	<0.01	<0.01	0
Methylene chloride	mg/kg wwt	0.01	0.364	0.35741	1.83
n-Butylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
n-Propylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
o-Xylene	mg/kg wwt	0.01	<0.01	<0.01	0
p-Isopropyltoluene	mg/kg wwt	0.01	<0.01	<0.01	0
sec-Butylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
Styrene	mg/kg wwt	0.01	<0.01	<0.01	0
tert-Butylbenzene	mg/kg wwt	0.01	<0.01	<0.01	0
Tetrachloroethene	mg/kg wwt	0.01	<0.01	<0.01	0
Thiophene	mg/kg wwt	0.01	<0.01	<0.01	0
Toluene	mg/kg wwt	0.01	<0.01	<0.01	0
trans-1,2-Dichloroethene	mg/kg wwt	0.01	<0.01	<0.01	0
trans-1,3-Dichloropropene	mg/kg wwt	0.01	<0.01	<0.01	0
Trichloroethene	mg/kg wwt	0.01	<0.01	<0.01	0
Trichlorofluoromethane	mg/kg wwt	0.01	<0.01	<0.01	0
Vinyl chloride	mg/kg wwt	0.2	<0.2	<0.2	0

[1] Relative percent difference (RPD) = (difference between sample 1 and 2)/(average of sample 1 and 2) x 100%. RPD for undetectable analytes (i.e., < detection limit) was calculated assuming a concentration equal to the detection limit. Precision is influenced by how close the analytical value is to the method detection limit. Thus, assessing percent mean differences is valid only for analytical values that are at least five times the detection limit.

#	Analytes differ by > 20% between duplicates but 1 or both concentrations are < 5 times the detection limit.
#	Analytes differ by > 20% between duplicates and concentrations are > 5 times the detection limit.

Appendix A9

Water Quality Data

Maxxam
A Bureau Veritas Group Company

Your Project #: CNRL9078
Your C.O.C. #: 1 OF 1

Attention: Meghan Isaacs
HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2018/09/21
Report #: R2623095
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B876287
Received: 2018/09/06, 13:55

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	3	N/A	2018/09/10	AB SOP-00005	SM 23 2320 B m
Biochemical Oxygen Demand	3	2018/09/07	2018/09/12	AB SOP-00017	SM 22 5210B m
Cadmium - low level CCME - Dissolved	3	N/A	2018/09/09	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total)	3	N/A	2018/09/11	AB WI-00065	Auto Calc
Chlorophyll A (water)(sin) (1)	3	2018/09/07	2018/09/18	BBY6SOP-00002	SM 22 10200 H m
Chloride by Automated Colourimetry	1	N/A	2018/09/12	AB SOP-00020	SM 22-4500-Cl-E m
Chloride by Automated Colourimetry	2	N/A	2018/09/13	AB SOP-00020	SM 22-4500-Cl-E m
True Colour (2)	3	N/A	2018/09/07	CAL SOP-00049	SM 23 2120 C m
Carbon (DOC) -Lab Filtered (3)	3	N/A	2018/09/10	CAL SOP-00077	MMCW 119 1996 m
Conductivity @25C	3	N/A	2018/09/10	AB SOP-00005	SM 23 2510 B m
Sulphide (as H2S)	3	N/A	2018/09/10	AB WI-00065	Auto Calc
Hardness	3	N/A	2018/09/08	AB WI-00065	Auto Calc
Mercury by Gold Trap-CVAF Ultra-Low(Dis) (1)	3	N/A	2018/09/18	BBY7SOP-00022	EPA 1631E m
Mercury by Gold Trap-CVAF Ultra-Low(Tot) (1)	3	2018/09/17	2018/09/18	BBY7SOP-00022	EPA 1631E m
Elements by ICP-Dissolved-Lab Filtered (4)	3	N/A	2018/09/07	AB SOP-00042	EPA 6010d R4 m
Elements by ICP - Total	3	2018/09/10	2018/09/10	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS-Dissolved-Lab Filtered (5)	3	N/A	2018/09/08	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	3	2018/09/10	2018/09/11	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Ion Balance	3	N/A	2018/09/07	AB WI-00065	Auto Calc
Sum of cations, anions	3	N/A	2018/09/08	AB WI-00065	Auto Calc
Nitrogen (total), Calc. TKN, NO3, NO2	3	N/A	2018/09/11	AB WI-00065	Auto Calc
Naphthenic Acids by IR	3	2018/09/07	2018/09/11	AB SOP-00060	EPA 3510C R3 / FTIR
Ammonia-N (Total)	3	N/A	2018/09/11	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate and Nitrite	3	N/A	2018/09/10	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	3	N/A	2018/09/10	AB WI-00065	Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	3	N/A	2018/09/08	AB SOP-00023	SM 23 4110 B m
pH @25°C (6)	3	N/A	2018/09/10	AB SOP-00005	SM 23 4500-H+B m
Phenols (4-AAP)	3	N/A	2018/09/11	CAL SOP-00067	EPA 9066 R0 m
Total Sulphide	3	N/A	2018/09/09	AB SOP-00080	SM 22 4500 S2-A D Fm

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Your Project #: CNRL9078
Your C.O.C. #: 1 OF 1

Attention: Meghan Isaacs

HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2018/09/21
Report #: R2623095
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B876287
Received: 2018/09/06, 13:55

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sulphate by Automated Colourimetry	1	N/A	2018/09/12	AB SOP-00018	SM 22 4500-SO4 E m
Sulphate by Automated Colourimetry	2	N/A	2018/09/13	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Filt. Residue)	3	2018/09/11	2018/09/11	AB SOP-00065	SM 22 2540 C m
Total Dissolved Solids (Calculated)	1	N/A	2018/09/12	AB WI-00065	Auto Calc
Total Dissolved Solids (Calculated)	2	N/A	2018/09/13	AB WI-00065	Auto Calc
Total Kjeldahl Nitrogen	3	2018/09/11	2018/09/11	AB SOP-00008	EPA 351.1 R1978 m
Carbon (Total Organic) (7)	3	N/A	2018/09/10	CAL SOP-00077	MMCW 119 1996 m
Total Phoshphorus-Dis-Low-Lab Filtered	3	2018/09/10	2018/09/12	AB SOP-00024	SM 22 4500-P A,B,F m
Total Phosphorus Low Level Total	3	2018/09/10	2018/09/12	AB SOP-00024	SM 22 4500-P A,B,F m
Hydrocarbon by IR (Mineral oil & grease)	3	2018/09/10	2018/09/11	CAL SOP-00096	SM 22 5520 C,F m
Total Suspended Solids (NFR)	3	2018/09/12	2018/09/12	AB SOP-00061	SM 23 2540 D m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing. Maxxam is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

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Maxxam
A Bureau Veritas Group Company

Your Project #: CNRL9078
Your C.O.C. #: 1 OF 1

Attention: Meghan Isaacs

HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2018/09/21
Report #: R2623095
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B876287
Received: 2018/09/06, 13:55

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Vancouver
(2) Analysis completed within 48h after laboratory receipt to a maximum of five days from sampling is satisfactory for compliance purposes.
(3) DOC present in the sample should be considered as non-purgeable DOC. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(4) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(5) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(6) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Maxxam endeavours to analyze samples as soon as possible after receipt.
(7) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key [redacted]

Geraldlyn Gouthro
Client Service Specialist
21 Sep 2018 13:31:51

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Geraldlyn Gouthro, Client Service Specialist
Email: GGouthro@maxxam.ca
Phone# (403)735-2230

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam
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Maxxam Job #: B876287
Report Date: 2018/09/21

HATFIELD CONSULTANTS
Client Project #: CNRL9078

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		UG2399		UG2400	UG2401		
Sampling Date		2018/09/06 10:00		2018/09/06 10:00	2018/09/06 09:50		
COC Number		1 OF 1		1 OF 1	1 OF 1		
	UNITS	HZL 1 TO 3 COMP.	QC Batch	SP-1	HZL-FB	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	2.5	9133492	2.5	0.0000	N/A	9133492
Cation Sum	meq/L	2.6	9133492	2.5	0.0020	N/A	9133492
Hardness (CaCO3)	mg/L	110	9132954	110	<0.50	0.50	9132954
Ion Balance (% Difference)	%	1.1	9133487	0.56	NC	N/A	9133487
Dissolved Nitrate (NO3)	mg/L	0.089	9133188	0.10	<0.044	0.044	9133188
Nitrate plus Nitrite (N)	mg/L	0.020	9133194	0.034	<0.014	0.014	9133194
Dissolved Nitrite (NO2)	mg/L	<0.033	9133188	0.033	<0.033	0.033	9133188
Sulphide (as H2S)	mg/L	<0.0020	9133476	<0.0020	<0.0020	0.0020	9133476
Calculated Total Dissolved Solids	mg/L	130	9133513	130	<10	10	9133513
Demand Parameters							
Biochemical Oxygen Demand	mg/L	4.3	9132945	4.5	<2.0	2.0	9132945
Misc. Inorganics							
Conductivity	uS/cm	240	9135468	240	<2.0	2.0	9135468
pH	pH	8.01	9135467	8.02	5.62	N/A	9135467
Total Organic Carbon (C)	mg/L	18	9135481	17	<0.50	0.50	9135481
Total Dissolved Solids	mg/L	180	9137058	180	<10	10	9137058
Total Suspended Solids	mg/L	3.3	9138830	3.5	<1.0	1.0	9138830
Lab Filtered Inorganics							
Dissolved Organic Carbon (C)	mg/L	17	9135483	18	<0.50	0.50	9135483
Low Level Elements							
Dissolved Cadmium (Cd)	ug/L	<0.020	9132947	<0.020	<0.020	0.020	9132947
Total Cadmium (Cd)	ug/L	<0.020	9132949	<0.020	0.022	0.020	9132949
Anions							
Alkalinity (PP as CaCO3)	mg/L	<1.0	9135465	<1.0	<1.0	1.0	9135465
Alkalinity (Total as CaCO3)	mg/L	95	9135465	95	<1.0	1.0	9135465
Bicarbonate (HCO3)	mg/L	120	9135465	120	<1.0	1.0	9135465
Carbonate (CO3)	mg/L	<1.0	9135465	<1.0	<1.0	1.0	9135465
Hydroxide (OH)	mg/L	<1.0	9135465	<1.0	<1.0	1.0	9135465
Dissolved Sulphate (SO4)	mg/L	27	9139231	27	<1.0	1.0	9140881
Total Sulphide	mg/L	<0.0019	9135198	<0.0019	<0.0019	0.0019	9135198
Dissolved Chloride (Cl)	mg/L	1.5	9139228	1.2	<1.0	1.0	9140879

RDL = Reportable Detection Limit
N/A = Not Applicable

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RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		UG2399		UG2400	UG2401		
Sampling Date		2018/09/06 10:00		2018/09/06 10:00	2018/09/06 09:50		
COC Number		1 OF 1		1 OF 1	1 OF 1		
	UNITS	HZL 1 TO 3 COMP.	QC Batch	SP-1	HZL-FB	RDL	QC Batch
MISCELLANEOUS							
Chlorophyll a	ug/L	18.0	9146616	18.7	0.98	0.50	9146616
Nutrients							
Total Ammonia (N)	mg/L	0.033	9138136	0.020	<0.015	0.015	9138136
Total Nitrogen (N)	mg/L	0.61	9133331	0.70	<0.055	0.055	9133331
Total Phosphorus (P)	mg/L	0.053	9135499	0.050	<0.0010	0.0010	9135499
Total Total Kjeldahl Nitrogen	mg/L	0.59	9136996	0.66	<0.050	0.050	9136996
Dissolved Nitrite (N)	mg/L	<0.010	9134145	0.010	<0.010	0.010	9134145
Dissolved Nitrate (N)	mg/L	0.020	9134145	0.024	<0.010	0.010	9134145
Lab Filtered Nutrients							
Dissolved Phosphorus (P)	mg/L	0.0073	9135505	0.012	<0.0010	0.0010	9135505
Misc. Organics							
Naphthenic Acids	mg/L	<1.0	9132297	<1.0	<1.0	1.0	9132297
Phenols	mg/L	0.0065	9136520	0.0050	<0.0020	0.0020	9136520
Total Petroleum Hydrocarbon	mg/L	<2.0	9132309	<2.0	<2.0	2.0	9132309
Physical Properties							
True Colour	PtCo units	23	9133380	52	<2.0	2.0	9133380
RDL = Reportable Detection Limit							

MERCURY BY COLD VAPOR (WATER)

Maxxam ID		UG2399	UG2400		UG2401		
Sampling Date		2018/09/06 10:00	2018/09/06 10:00		2018/09/06 09:50		
COC Number		1 OF 1	1 OF 1		1 OF 1		
	UNITS	HZL 1 TO 3 COMP.	SP-1	QC Batch	HZL-FB	RDL	QC Batch
Elements							
Dissolved Mercury (Hg)	ng/L	0.55	1.1	9146388	<0.10	0.10	9146388
Total Mercury (Hg)	ng/L	0.42	1.2	9146267	<0.10	0.10	9146392
RDL = Reportable Detection Limit							

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ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		UG2399	UG2400	UG2401		
Sampling Date		2018/09/06 10:00	2018/09/06 10:00	2018/09/06 09:50		
COC Number		1 OF 1	1 OF 1	1 OF 1		
	UNITS	HZL 1 TO 3 COMP.	SP-1	HZL-FB	RDL	QC Batch
Elements						
Total Aluminum (Al)	mg/L	0.051	0.051	0.017	0.0030	9135787
Total Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	0.00060	9135787
Total Arsenic (As)	mg/L	0.0016	0.0015	<0.00020	0.00020	9135787
Total Barium (Ba)	mg/L	0.034	0.033	<0.010	0.010	9135763
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9135787
Total Boron (B)	mg/L	0.051	0.051	<0.020	0.020	9135763
Total Calcium (Ca)	mg/L	32	31	<0.30	0.30	9135763
Total Chromium (Cr)	mg/L	0.0014	0.0017	0.0015	0.0010	9135787
Total Cobalt (Co)	mg/L	<0.00030	<0.00030	<0.00030	0.00030	9135787
Total Copper (Cu)	mg/L	0.0012	0.0012	0.00025	0.00020	9135787
Total Iron (Fe)	mg/L	0.32	0.31	<0.060	0.060	9135763
Total Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9135787
Total Lithium (Li)	mg/L	<0.020	<0.020	<0.020	0.020	9135763
Total Magnesium (Mg)	mg/L	8.8	8.6	<0.20	0.20	9135763
Total Manganese (Mn)	mg/L	0.10	0.099	<0.0040	0.0040	9135763
Total Molybdenum (Mo)	mg/L	0.0013	0.0013	<0.00020	0.00020	9135787
Total Nickel (Ni)	mg/L	0.0026	0.0029	<0.00050	0.00050	9135787
Total Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	9135763
Total Potassium (K)	mg/L	1.3	1.3	<0.30	0.30	9135763
Total Selenium (Se)	mg/L	0.00028	0.00028	0.00025	0.00020	9135787
Total Silicon (Si)	mg/L	2.3	2.2	<0.10	0.10	9135763
Total Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	9135787
Total Sodium (Na)	mg/L	8.9	8.6	<0.50	0.50	9135763
Total Strontium (Sr)	mg/L	0.12	0.12	<0.020	0.020	9135763
Total Sulphur (S)	mg/L	8.0	7.8	<0.20	0.20	9135763
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9135787
Total Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9135787
Total Titanium (Ti)	mg/L	0.0025	<0.0010	<0.0010	0.0010	9135787
Total Uranium (U)	mg/L	0.00032	0.00025	<0.00010	0.00010	9135787
Total Vanadium (V)	mg/L	0.0021	0.0020	0.0015	0.0010	9135787
Total Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0030	9135787

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		UG2399	UG2400	UG2401		
Sampling Date		2018/09/06 10:00	2018/09/06 10:00	2018/09/06 09:50		
COC Number		1 OF 1	1 OF 1	1 OF 1		
	UNITS	**HZL 1 TO 3 COMP.**	**SP-1**	**HZL-FB**	**RDL**	**QC Batch**
Lab Filtered Elements						
Dissolved Aluminum (Al)	mg/L	<0.0030	0.0054	<0.0030	0.0030	9134108
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	0.00060	9134108
Dissolved Arsenic (As)	mg/L	0.0012	0.0013	<0.00020	0.00020	9134108
Dissolved Barium (Ba)	mg/L	0.029	0.028	<0.010	0.010	9134163
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9134108
Dissolved Boron (B)	mg/L	0.047	0.048	<0.020	0.020	9134163
Dissolved Calcium (Ca)	mg/L	30	29	<0.30	0.30	9134163
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9134108
Dissolved Cobalt (Co)	mg/L	<0.00030	<0.00030	<0.00030	0.00030	9134108
Dissolved Copper (Cu)	mg/L	0.00056	0.00067	<0.00020	0.00020	9134108
Dissolved Iron (Fe)	mg/L	<0.060	0.064	<0.060	0.060	9134163
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9134108
Dissolved Lithium (Li)	mg/L	<0.020	<0.020	<0.020	0.020	9134163
Dissolved Magnesium (Mg)	mg/L	8.3	8.1	<0.20	0.20	9134163
Dissolved Manganese (Mn)	mg/L	<0.0040	<0.0040	<0.0040	0.0040	9134163
Dissolved Molybdenum (Mo)	mg/L	0.00097	0.0012	<0.00020	0.00020	9134108
Dissolved Nickel (Ni)	mg/L	0.0023	0.0029	<0.00050	0.00050	9134108
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	9134163
Dissolved Potassium (K)	mg/L	1.1	1.1	<0.30	0.30	9134163
Dissolved Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9134108
Dissolved Silicon (Si)	mg/L	1.8	1.8	<0.10	0.10	9134163
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	9134108
Dissolved Sodium (Na)	mg/L	8.1	7.9	<0.50	0.50	9134163
Dissolved Strontium (Sr)	mg/L	0.11	0.11	<0.020	0.020	9134163
Dissolved Sulphur (S)	mg/L	7.3	7.6	<0.20	0.20	9134163
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9134108
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9134108
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9134108
Dissolved Uranium (U)	mg/L	0.00023	0.00026	<0.00010	0.00010	9134108
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9134108
Dissolved Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0030	9134108

RDL = Reportable Detection Limit

GENERAL COMMENTS

Results relate only to the items tested.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B876287
Report Date: 2018/09/21

HATFIELD CONSULTANTS
Client Project #: CNRL9078

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9132297	MWB	Matrix Spike	Naphthenic Acids	2018/09/11		94	%	70 - 130
9132297	MWB	Spiked Blank	Naphthenic Acids	2018/09/11		90	%	70 - 130
9132297	MWB	Method Blank	Naphthenic Acids	2018/09/11	<1.0		mg/L	
9132297	MWB	RPD	Naphthenic Acids	2018/09/11	NC		%	30
9132309	MWB	Matrix Spike	Total Petroleum Hydrocarbon	2018/09/11		98	%	70 - 130
9132309	MWB	Spiked Blank	Total Petroleum Hydrocarbon	2018/09/11		97	%	70 - 130
9132309	MWB	Method Blank	Total Petroleum Hydrocarbon	2018/09/11	<2.0		mg/L	
9132309	MWB	RPD	Total Petroleum Hydrocarbon	2018/09/11	NC		%	30
9132945	JM0	Spiked Blank	Biochemical Oxygen Demand	2018/09/12		97	%	85 - 115
9132945	JM0	Method Blank	Biochemical Oxygen Demand	2018/09/12	<2.0		mg/L	
9132945	JM0	RPD	Biochemical Oxygen Demand	2018/09/12	1.1		%	20
9133380	KHC	Matrix Spike	True Colour	2018/09/07		113	%	80 - 120
9133380	KHC	Spiked Blank	True Colour	2018/09/07		100	%	80 - 120
9133380	KHC	Method Blank	True Colour	2018/09/07	<2.0		PtCo units	
9133380	KHC	RPD	True Colour	2018/09/07	0.70		%	20
9134108	HC7	Matrix Spike	Dissolved Aluminum (Al)	2018/09/08		104	%	80 - 120
			Dissolved Antimony (Sb)	2018/09/08		98	%	80 - 120
			Dissolved Arsenic (As)	2018/09/08		100	%	80 - 120
			Dissolved Beryllium (Be)	2018/09/08		105	%	80 - 120
			Dissolved Chromium (Cr)	2018/09/08		97	%	80 - 120
			Dissolved Cobalt (Co)	2018/09/08		96	%	80 - 120
			Dissolved Copper (Cu)	2018/09/08		96	%	80 - 120
			Dissolved Lead (Pb)	2018/09/08		95	%	80 - 120
			Dissolved Molybdenum (Mo)	2018/09/08		99	%	80 - 120
			Dissolved Nickel (Ni)	2018/09/08		96	%	80 - 120
			Dissolved Selenium (Se)	2018/09/08		98	%	80 - 120
			Dissolved Silver (Ag)	2018/09/08		99	%	80 - 120
			Dissolved Thallium (Tl)	2018/09/08		96	%	80 - 120
			Dissolved Tin (Sn)	2018/09/08		96	%	80 - 120
			Dissolved Titanium (Ti)	2018/09/08		101	%	80 - 120
			Dissolved Uranium (U)	2018/09/08		92	%	80 - 120
			Dissolved Vanadium (V)	2018/09/08		98	%	80 - 120
			Dissolved Zinc (Zn)	2018/09/08		100	%	80 - 120
9134108	HC7	Spiked Blank	Dissolved Aluminum (Al)	2018/09/08		106	%	80 - 120
			Dissolved Antimony (Sb)	2018/09/08		97	%	80 - 120
			Dissolved Arsenic (As)	2018/09/08		98	%	80 - 120
			Dissolved Beryllium (Be)	2018/09/08		102	%	80 - 120
			Dissolved Chromium (Cr)	2018/09/08		94	%	80 - 120
			Dissolved Cobalt (Co)	2018/09/08		98	%	80 - 120
			Dissolved Copper (Cu)	2018/09/08		97	%	80 - 120
			Dissolved Lead (Pb)	2018/09/08		96	%	80 - 120
			Dissolved Molybdenum (Mo)	2018/09/08		98	%	80 - 120
			Dissolved Nickel (Ni)	2018/09/08		99	%	80 - 120
			Dissolved Selenium (Se)	2018/09/08		97	%	80 - 120
			Dissolved Silver (Ag)	2018/09/08		97	%	80 - 120
			Dissolved Thallium (Tl)	2018/09/08		95	%	80 - 120
			Dissolved Tin (Sn)	2018/09/08		98	%	80 - 120
			Dissolved Titanium (Ti)	2018/09/08		91	%	80 - 120
			Dissolved Uranium (U)	2018/09/08		93	%	80 - 120
			Dissolved Vanadium (V)	2018/09/08		100	%	80 - 120
			Dissolved Zinc (Zn)	2018/09/08		101	%	80 - 120
9134108	HC7	Method Blank	Dissolved Aluminum (Al)	2018/09/08	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2018/09/08	<0.00060		mg/L	
			Dissolved Arsenic (As)	2018/09/08	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2018/09/08	<0.0010		mg/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291 9468

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Chromium (Cr)	2018/09/08	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2018/09/08	<0.00030		mg/L	
			Dissolved Copper (Cu)	2018/09/08	<0.00020		mg/L	
			Dissolved Lead (Pb)	2018/09/08	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2018/09/08	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2018/09/08	<0.00050		mg/L	
			Dissolved Selenium (Se)	2018/09/08	<0.00020		mg/L	
			Dissolved Silver (Ag)	2018/09/08	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2018/09/08	<0.00020		mg/L	
			Dissolved Tin (Sn)	2018/09/08	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2018/09/08	<0.0010		mg/L	
			Dissolved Uranium (U)	2018/09/08	<0.00010		mg/L	
			Dissolved Vanadium (V)	2018/09/08	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2018/09/08	<0.0030		mg/L	
9134108	HC7	RPD	Dissolved Aluminum (Al)	2018/09/08	6.0		%	20
			Dissolved Antimony (Sb)	2018/09/08	NC		%	20
			Dissolved Arsenic (As)	2018/09/08	NC		%	20
			Dissolved Beryllium (Be)	2018/09/08	NC		%	20
			Dissolved Chromium (Cr)	2018/09/08	NC		%	20
			Dissolved Cobalt (Co)	2018/09/08	NC		%	20
			Dissolved Copper (Cu)	2018/09/08	0.83		%	20
			Dissolved Lead (Pb)	2018/09/08	NC		%	20
			Dissolved Molybdenum (Mo)	2018/09/08	NC		%	20
			Dissolved Nickel (Ni)	2018/09/08	NC		%	20
			Dissolved Selenium (Se)	2018/09/08	NC		%	20
			Dissolved Silver (Ag)	2018/09/08	NC		%	20
			Dissolved Thallium (Tl)	2018/09/08	NC		%	20
			Dissolved Tin (Sn)	2018/09/08	NC		%	20
			Dissolved Titanium (Ti)	2018/09/08	NC		%	20
			Dissolved Uranium (U)	2018/09/08	NC		%	20
			Dissolved Vanadium (V)	2018/09/08	NC		%	20
			Dissolved Zinc (Zn)	2018/09/08	5.1		%	20
9134145	KD9	Matrix Spike	Dissolved Nitrite (N)	2018/09/08		102	%	80 - 120
			Dissolved Nitrate (N)	2018/09/08		103	%	80 - 120
9134145	KD9	Spiked Blank	Dissolved Nitrite (N)	2018/09/08		102	%	80 - 120
			Dissolved Nitrate (N)	2018/09/08		103	%	80 - 120
9134145	KD9	Method Blank	Dissolved Nitrite (N)	2018/09/08	<0.010		mg/L	
			Dissolved Nitrate (N)	2018/09/08	<0.010		mg/L	
9134145	KD9	RPD	Dissolved Nitrite (N)	2018/09/08	NC		%	20
			Dissolved Nitrate (N)	2018/09/08	1.3		%	20
9134163	FM0	Matrix Spike	Dissolved Barium (Ba)	2018/09/07		91	%	80 - 120
			Dissolved Boron (B)	2018/09/07		92	%	80 - 120
			Dissolved Calcium (Ca)	2018/09/07		93	%	80 - 120
			Dissolved Iron (Fe)	2018/09/07		93	%	80 - 120
			Dissolved Lithium (Li)	2018/09/07		92	%	80 - 120
			Dissolved Magnesium (Mg)	2018/09/07		92	%	80 - 120
			Dissolved Manganese (Mn)	2018/09/07		91	%	80 - 120
			Dissolved Phosphorus (P)	2018/09/07		95	%	80 - 120
			Dissolved Potassium (K)	2018/09/07		94	%	80 - 120
			Dissolved Silicon (Si)	2018/09/07		90	%	80 - 120
			Dissolved Sodium (Na)	2018/09/07		93	%	80 - 120
			Dissolved Strontium (Sr)	2018/09/07		89	%	80 - 120
9134163	FM0	Spiked Blank	Dissolved Barium (Ba)	2018/09/07		93	%	80 - 120
			Dissolved Boron (B)	2018/09/07		92	%	80 - 120
			Dissolved Calcium (Ca)	2018/09/07		95	%	80 - 120

Maxxam
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Maxxam Job #: B876287
Report Date: 2018/09/21

HATFIELD CONSULTANTS
Client Project #: CNRL9078

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Iron (Fe)	2018/09/07		94	%	80 - 120
			Dissolved Lithium (Li)	2018/09/07		93	%	80 - 120
			Dissolved Magnesium (Mg)	2018/09/07		95	%	80 - 120
			Dissolved Manganese (Mn)	2018/09/07		94	%	80 - 120
			Dissolved Phosphorus (P)	2018/09/07		92	%	80 - 120
			Dissolved Potassium (K)	2018/09/07		93	%	80 - 120
			Dissolved Silicon (Si)	2018/09/07		94	%	80 - 120
			Dissolved Sodium (Na)	2018/09/07		94	%	80 - 120
			Dissolved Strontium (Sr)	2018/09/07		92	%	80 - 120
9134163	FM0	Method Blank	Dissolved Barium (Ba)	2018/09/07	<0.010		mg/L	
			Dissolved Boron (B)	2018/09/07	<0.020		mg/L	
			Dissolved Calcium (Ca)	2018/09/07	<0.30		mg/L	
			Dissolved Iron (Fe)	2018/09/07	<0.060		mg/L	
			Dissolved Lithium (Li)	2018/09/07	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2018/09/07	<0.20		mg/L	
			Dissolved Manganese (Mn)	2018/09/07	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2018/09/07	<0.10		mg/L	
			Dissolved Potassium (K)	2018/09/07	<0.30		mg/L	
			Dissolved Silicon (Si)	2018/09/07	<0.10		mg/L	
			Dissolved Sodium (Na)	2018/09/07	<0.50		mg/L	
			Dissolved Strontium (Sr)	2018/09/07	<0.020		mg/L	
			Dissolved Sulphur (S)	2018/09/07	<0.20		mg/L	
9134163	FM0	RPD	Dissolved Calcium (Ca)	2018/09/07	1.1		%	20
			Dissolved Iron (Fe)	2018/09/07	NC		%	20
			Dissolved Magnesium (Mg)	2018/09/07	0.93		%	20
			Dissolved Manganese (Mn)	2018/09/07	3.3		%	20
			Dissolved Potassium (K)	2018/09/07	3.2		%	20
			Dissolved Sodium (Na)	2018/09/07	8.0		%	20
9135198	XLI	Spiked Blank	Total Sulphide	2018/09/09		97	%	80 - 120
9135198	XLI	Method Blank	Total Sulphide	2018/09/09	<0.0019		mg/L	
9135198	XLI	RPD	Total Sulphide	2018/09/09	NC		%	20
9135465	IK0	Spiked Blank	Alkalinity (Total as CaCO3)	2018/09/10		93	%	80 - 120
9135465	IK0	Method Blank	Alkalinity (PP as CaCO3)	2018/09/10	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2018/09/10	<1.0		mg/L	
			Bicarbonate (HCO3)	2018/09/10	<1.0		mg/L	
			Carbonate (CO3)	2018/09/10	<1.0		mg/L	
			Hydroxide (OH)	2018/09/10	<1.0		mg/L	
9135465	IK0	RPD	Alkalinity (PP as CaCO3)	2018/09/10	NC		%	20
			Alkalinity (Total as CaCO3)	2018/09/10	0.29		%	20
			Bicarbonate (HCO3)	2018/09/10	0.29		%	20
			Carbonate (CO3)	2018/09/10	NC		%	20
			Hydroxide (OH)	2018/09/10	NC		%	20
9135467	IK0	Spiked Blank	pH	2018/09/10		101	%	97 - 103
9135467	IK0	RPD	pH	2018/09/10	1.6		%	N/A
9135468	IK0	Spiked Blank	Conductivity	2018/09/10		100	%	90 - 110
9135468	IK0	Method Blank	Conductivity	2018/09/10	<2.0		uS/cm	
9135468	IK0	RPD	Conductivity	2018/09/10	0		%	10
9135481	KGH	Matrix Spike	Total Organic Carbon (C)	2018/09/10		110	%	80 - 120
9135481	KGH	Spiked Blank	Total Organic Carbon (C)	2018/09/10		98	%	80 - 120
9135481	KGH	Method Blank	Total Organic Carbon (C)	2018/09/10	<0.50		mg/L	
9135481	KGH	RPD	Total Organic Carbon (C)	2018/09/10	NC		%	20
9135483	KGH	Matrix Spike	Dissolved Organic Carbon (C)	2018/09/10		107	%	80 - 120
9135483	KGH	Spiked Blank	Dissolved Organic Carbon (C)	2018/09/10		96	%	80 - 120
9135483	KGH	Method Blank	Dissolved Organic Carbon (C)	2018/09/10	<0.50		mg/L	
9135483	KGH	RPD	Dissolved Organic Carbon (C)	2018/09/10	2.6		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9135499	JLD	Matrix Spike	Total Phosphorus (P)	2018/09/12		105	%	80 - 120
9135499	JLD	QC Standard	Total Phosphorus (P)	2018/09/12		95	%	80 - 120
9135499	JLD	Spiked Blank	Total Phosphorus (P)	2018/09/12		103	%	80 - 120
9135499	JLD	Method Blank	Total Phosphorus (P)	2018/09/12	<0.0010		mg/L	
9135499	JLD	RPD	Total Phosphorus (P)	2018/09/12	NC		%	20
9135505	JLD	Matrix Spike [UG2400-01]	Dissolved Phosphorus (P)	2018/09/12		108	%	80 - 120
9135505	JLD	QC Standard	Dissolved Phosphorus (P)	2018/09/12		96	%	80 - 120
9135505	JLD	Spiked Blank	Dissolved Phosphorus (P)	2018/09/12		102	%	80 - 120
9135505	JLD	Method Blank	Dissolved Phosphorus (P)	2018/09/12	<0.0010		mg/L	
9135505	JLD	RPD [UG2401-01]	Dissolved Phosphorus (P)	2018/09/12	NC		%	20
9135763	MAP	Matrix Spike	Total Barium (Ba)	2018/09/10		97	%	80 - 120
			Total Boron (B)	2018/09/10		99	%	80 - 120
			Total Calcium (Ca)	2018/09/10		NC	%	80 - 120
			Total Iron (Fe)	2018/09/10		102	%	80 - 120
			Total Lithium (Li)	2018/09/10		96	%	80 - 120
			Total Magnesium (Mg)	2018/09/10		102	%	80 - 120
			Total Manganese (Mn)	2018/09/10		100	%	80 - 120
			Total Phosphorus (P)	2018/09/10		101	%	80 - 120
			Total Potassium (K)	2018/09/10		98	%	80 - 120
			Total Silicon (Si)	2018/09/10		105	%	80 - 120
			Total Sodium (Na)	2018/09/10		99	%	80 - 120
			Total Strontium (Sr)	2018/09/10		95	%	80 - 120
9135763	MAP	Spiked Blank	Total Barium (Ba)	2018/09/10		97	%	80 - 120
			Total Boron (B)	2018/09/10		98	%	80 - 120
			Total Calcium (Ca)	2018/09/10		102	%	80 - 120
			Total Iron (Fe)	2018/09/10		102	%	80 - 120
			Total Lithium (Li)	2018/09/10		95	%	80 - 120
			Total Magnesium (Mg)	2018/09/10		100	%	80 - 120
			Total Manganese (Mn)	2018/09/10		100	%	80 - 120
			Total Phosphorus (P)	2018/09/10		100	%	80 - 120
			Total Potassium (K)	2018/09/10		96	%	80 - 120
			Total Silicon (Si)	2018/09/10		104	%	80 - 120
			Total Sodium (Na)	2018/09/10		98	%	80 - 120
			Total Strontium (Sr)	2018/09/10		95	%	80 - 120
9135763	MAP	Method Blank	Total Barium (Ba)	2018/09/10	<0.010		mg/L	
			Total Boron (B)	2018/09/10	<0.020		mg/L	
			Total Calcium (Ca)	2018/09/10	<0.30		mg/L	
			Total Iron (Fe)	2018/09/10	<0.060		mg/L	
			Total Lithium (Li)	2018/09/10	<0.020		mg/L	
			Total Magnesium (Mg)	2018/09/10	<0.20		mg/L	
			Total Manganese (Mn)	2018/09/10	<0.0040		mg/L	
			Total Phosphorus (P)	2018/09/10	<0.10		mg/L	
			Total Potassium (K)	2018/09/10	<0.30		mg/L	
			Total Silicon (Si)	2018/09/10	<0.10		mg/L	
			Total Sodium (Na)	2018/09/10	<0.50		mg/L	
			Total Strontium (Sr)	2018/09/10	<0.020		mg/L	
			Total Sulphur (S)	2018/09/10	<0.20		mg/L	
9135763	MAP	RPD	Total Barium (Ba)	2018/09/10	2.7		%	20
			Total Boron (B)	2018/09/10	NC		%	20
			Total Calcium (Ca)	2018/09/10	2.7		%	20
			Total Iron (Fe)	2018/09/10	1.4		%	20
			Total Lithium (Li)	2018/09/10	NC		%	20
			Total Magnesium (Mg)	2018/09/10	2.8		%	20
			Total Manganese (Mn)	2018/09/10	1.9		%	20
			Total Phosphorus (P)	2018/09/10	NC		%	20

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Potassium (K)	2018/09/10	6.5		%	20
			Total Silicon (Si)	2018/09/10	1.8		%	20
			Total Sodium (Na)	2018/09/10	2.5		%	20
			Total Strontium (Sr)	2018/09/10	2.4		%	20
			Total Sulphur (S)	2018/09/10	2.0		%	20
9135787	PC5	Matrix Spike	Total Aluminum (Al)	2018/09/11		NC	%	80 - 120
			Total Antimony (Sb)	2018/09/11		99	%	80 - 120
			Total Arsenic (As)	2018/09/11		102	%	80 - 120
			Total Beryllium (Be)	2018/09/11		98	%	80 - 120
			Total Chromium (Cr)	2018/09/11		103	%	80 - 120
			Total Cobalt (Co)	2018/09/11		100	%	80 - 120
			Total Copper (Cu)	2018/09/11		98	%	80 - 120
			Total Lead (Pb)	2018/09/11		98	%	80 - 120
			Total Molybdenum (Mo)	2018/09/11		106	%	80 - 120
			Total Nickel (Ni)	2018/09/11		101	%	80 - 120
			Total Selenium (Se)	2018/09/11		102	%	80 - 120
			Total Silver (Ag)	2018/09/11		103	%	80 - 120
			Total Thallium (Tl)	2018/09/11		99	%	80 - 120
			Total Tin (Sn)	2018/09/11		106	%	80 - 120
			Total Titanium (Ti)	2018/09/11		95	%	80 - 120
			Total Uranium (U)	2018/09/11		100	%	80 - 120
			Total Vanadium (V)	2018/09/11		107	%	80 - 120
			Total Zinc (Zn)	2018/09/11		NC	%	80 - 120
9135787	PC5	Spiked Blank	Total Aluminum (Al)	2018/09/11		100	%	80 - 120
			Total Antimony (Sb)	2018/09/11		103	%	80 - 120
			Total Arsenic (As)	2018/09/11		102	%	80 - 120
			Total Beryllium (Be)	2018/09/11		98	%	80 - 120
			Total Chromium (Cr)	2018/09/11		103	%	80 - 120
			Total Cobalt (Co)	2018/09/11		102	%	80 - 120
			Total Copper (Cu)	2018/09/11		102	%	80 - 120
			Total Lead (Pb)	2018/09/11		100	%	80 - 120
			Total Molybdenum (Mo)	2018/09/11		101	%	80 - 120
			Total Nickel (Ni)	2018/09/11		102	%	80 - 120
			Total Selenium (Se)	2018/09/11		102	%	80 - 120
			Total Silver (Ag)	2018/09/11		101	%	80 - 120
			Total Thallium (Tl)	2018/09/11		100	%	80 - 120
			Total Tin (Sn)	2018/09/11		102	%	80 - 120
			Total Titanium (Ti)	2018/09/11		102	%	80 - 120
			Total Uranium (U)	2018/09/11		99	%	80 - 120
			Total Vanadium (V)	2018/09/11		103	%	80 - 120
			Total Zinc (Zn)	2018/09/11		97	%	80 - 120
9135787	PC5	Method Blank	Total Aluminum (Al)	2018/09/11	<0.0030		mg/L	
			Total Antimony (Sb)	2018/09/11	<0.00060		mg/L	
			Total Arsenic (As)	2018/09/11	<0.00020		mg/L	
			Total Beryllium (Be)	2018/09/11	<0.0010		mg/L	
			Total Chromium (Cr)	2018/09/11	<0.0010		mg/L	
			Total Cobalt (Co)	2018/09/11	<0.00030		mg/L	
			Total Copper (Cu)	2018/09/11	<0.00020		mg/L	
			Total Lead (Pb)	2018/09/11	<0.00020		mg/L	
			Total Molybdenum (Mo)	2018/09/11	<0.00020		mg/L	
			Total Nickel (Ni)	2018/09/11	<0.00050		mg/L	
			Total Selenium (Se)	2018/09/11	<0.00020		mg/L	
			Total Silver (Ag)	2018/09/11	<0.00010		mg/L	
			Total Thallium (Tl)	2018/09/11	<0.00020		mg/L	
			Total Tin (Sn)	2018/09/11	<0.0010		mg/L	

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Maxxam Job #: B876287
Report Date: 2018/09/21

HATFIELD CONSULTANTS
Client Project #: CNRL9078

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Titanium (Ti)	2018/09/11	<0.0010		mg/L	
			Total Uranium (U)	2018/09/11	<0.00010		mg/L	
			Total Vanadium (V)	2018/09/11	<0.0010		mg/L	
			Total Zinc (Zn)	2018/09/11	<0.0030		mg/L	
9135787	PC5	RPD	Total Aluminum (Al)	2018/09/11	7.2		%	20
			Total Antimony (Sb)	2018/09/11	NC		%	20
			Total Arsenic (As)	2018/09/11	NC		%	20
			Total Beryllium (Be)	2018/09/11	NC		%	20
			Total Chromium (Cr)	2018/09/11	NC		%	20
			Total Cobalt (Co)	2018/09/11	6.8		%	20
			Total Copper (Cu)	2018/09/11	2.7		%	20
			Total Lead (Pb)	2018/09/11	NC		%	20
			Total Molybdenum (Mo)	2018/09/11	0.96		%	20
			Total Nickel (Ni)	2018/09/11	NC		%	20
			Total Selenium (Se)	2018/09/11	NC		%	20
			Total Silver (Ag)	2018/09/11	NC		%	20
			Total Thallium (Tl)	2018/09/11	NC		%	20
			Total Tin (Sn)	2018/09/11	NC		%	20
			Total Titanium (Ti)	2018/09/11	1.7		%	20
			Total Uranium (U)	2018/09/11	8.3		%	20
			Total Vanadium (V)	2018/09/11	2.9		%	20
			Total Zinc (Zn)	2018/09/11	10		%	20
9136520	KGH	Matrix Spike	Phenols	2018/09/11		98	%	80 - 120
9136520	KGH	Spiked Blank	Phenols	2018/09/11		96	%	80 - 120
9136520	KGH	Method Blank	Phenols	2018/09/11	<0.0020		mg/L	
9136520	KGH	RPD	Phenols	2018/09/11	NC		%	20
9136996	JLD	Matrix Spike	Total Total Kjeldahl Nitrogen	2018/09/11		81	%	80 - 120
9136996	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2018/09/11		82	%	80 - 120
9136996	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2018/09/11		84	%	80 - 120
9136996	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2018/09/11	<0.050		mg/L	
9136996	JLD	RPD	Total Total Kjeldahl Nitrogen	2018/09/11	NC		%	20
9137058	HE1	Matrix Spike	Total Dissolved Solids	2018/09/12		NC	%	80 - 120
9137058	HE1	Spiked Blank	Total Dissolved Solids	2018/09/11		102	%	80 - 120
9137058	HE1	Method Blank	Total Dissolved Solids	2018/09/11	<10		mg/L	
9137058	HE1	RPD	Total Dissolved Solids	2018/09/11	NC		%	20
9138136	JLD	Matrix Spike	Total Ammonia (N)	2018/09/11		NC	%	80 - 120
9138136	JLD	Spiked Blank	Total Ammonia (N)	2018/09/11		99	%	80 - 120
9138136	JLD	Method Blank	Total Ammonia (N)	2018/09/11	<0.015		mg/L	
9138136	JLD	RPD	Total Ammonia (N)	2018/09/11	8.3		%	20
9138830	AP1	Matrix Spike	Total Suspended Solids	2018/09/12		100	%	80 - 120
9138830	AP1	Spiked Blank	Total Suspended Solids	2018/09/12		90	%	80 - 120
9138830	AP1	Method Blank	Total Suspended Solids	2018/09/12	<1.0		mg/L	
9138830	AP1	RPD	Total Suspended Solids	2018/09/12	NC		%	20
9139228	ZI	Matrix Spike	Dissolved Chloride (Cl)	2018/09/12		NC	%	80 - 120
9139228	ZI	Spiked Blank	Dissolved Chloride (Cl)	2018/09/12		103	%	80 - 120
9139228	ZI	Method Blank	Dissolved Chloride (Cl)	2018/09/12	<1.0		mg/L	
9139228	ZI	RPD	Dissolved Chloride (Cl)	2018/09/12	2.0		%	20
9139231	ZI	Matrix Spike	Dissolved Sulphate (SO4)	2018/09/12		NC	%	80 - 120
9139231	ZI	Spiked Blank	Dissolved Sulphate (SO4)	2018/09/12		101	%	80 - 120
9139231	ZI	Method Blank	Dissolved Sulphate (SO4)	2018/09/12	<1.0		mg/L	
9139231	ZI	RPD	Dissolved Sulphate (SO4)	2018/09/12	0.75		%	20
9140879	ZI	Matrix Spike	Dissolved Chloride (Cl)	2018/09/13		113	%	80 - 120
9140879	ZI	Spiked Blank	Dissolved Chloride (Cl)	2018/09/13		105	%	80 - 120
9140879	ZI	Method Blank	Dissolved Chloride (Cl)	2018/09/13	<1.0		mg/L	
9140879	ZI	RPD	Dissolved Chloride (Cl)	2018/09/13	2.3		%	20

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Maxxam Job #: B876287
Report Date: 2018/09/21

HATFIELD CONSULTANTS
Client Project #: CNRL9078

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9140881	ZI	Matrix Spike	Dissolved Sulphate (SO4)	2018/09/13		NC	%	80 - 120
9140881	ZI	Spiked Blank	Dissolved Sulphate (SO4)	2018/09/13		101	%	80 - 120
9140881	ZI	Method Blank	Dissolved Sulphate (SO4)	2018/09/13	<1.0		mg/L	
9140881	ZI	RPD	Dissolved Sulphate (SO4)	2018/09/13	0.56		%	20
9146267	CJY	Matrix Spike	Total Mercury (Hg)	2018/09/18		84	%	70 - 130
9146267	CJY	QC Standard	Total Mercury (Hg)	2018/09/18		97	%	70 - 130
9146267	CJY	Spiked Blank	Total Mercury (Hg)	2018/09/18		95	%	70 - 130
9146267	CJY	Method Blank	Total Mercury (Hg)	2018/09/18	<0.10		ng/L	
9146267	CJY	RPD [UG2399-14]	Total Mercury (Hg)	2018/09/18	15		%	25
9146388	EL2	Matrix Spike [UG2401-09]	Dissolved Mercury (Hg)	2018/09/18		97	%	70 - 130
9146388	EL2	QC Standard	Dissolved Mercury (Hg)	2018/09/18		103	%	70 - 130
9146388	EL2	Spiked Blank	Dissolved Mercury (Hg)	2018/09/18		98	%	70 - 130
9146388	EL2	Method Blank	Dissolved Mercury (Hg)	2018/09/18	<0.10		ng/L	
9146388	EL2	RPD [UG2399-15]	Dissolved Mercury (Hg)	2018/09/18	NC		%	25
9146392	EL2	Matrix Spike	Total Mercury (Hg)	2018/09/18		92	%	70 - 130
9146392	EL2	QC Standard	Total Mercury (Hg)	2018/09/18		97	%	70 - 130
9146392	EL2	Spiked Blank	Total Mercury (Hg)	2018/09/18		97	%	70 - 130
9146392	EL2	Method Blank	Total Mercury (Hg)	2018/09/18	<0.10		ng/L	
9146392	EL2	RPD [UG2401-08]	Total Mercury (Hg)	2018/09/18	NC		%	25
9146616	PSA	Spiked Blank	Chlorophyll a	2018/09/18		104	%	80 - 120
9146616	PSA	Method Blank	Chlorophyll a	2018/09/18	<0.50		ug/L	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Success Through Sc

Maxxam Job #: B876287
Report Date: 2018/09/21

HATFIELD CONSULTANTS
Client Project #: CNRL9078

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

Gita Pokhrel, Senior Analyst

Harry (Peng) Liang, Senior Analyst

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

s.19(1)

Maxxam

Calgary: 4000 19st St. NE T2E 6P8 Ph: (403) 291 3077 Fax (403) 735 2240 Toll free (800) 386 7247
Edmonton: 9331 48 Street, T6B 2R4 Ph: (780) 577 7100, Fax (780) 450 4187, Toll free (877) 465 8889

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Chain of Custody
Page: 1 of 1

Company:	Invoice To: Hatfield Consultants
Contact:	Imsook Cha [redacted]
	Meghan Isaacs [redacted]
Address:	#200-850 Harbourside Drive, North Vancouver, BC, V7P 0A3
Contact #s:	604-926-3261

Report To:
Company: Hatfield
Contact: Meghan Isaacs, Dan Moats
Email:
Address:
Ph: 604-926-3261 Cell:

Report Distribution (E-Mail):
[redacted]

REGULATORY GUIDELINES:
- O AT1
- O CCME
- O Regulated Drinking Water
- O Other

All samples are held for 60 calendar days after sample receipt, unless specified otherwise

PO #:	
Project #: CNRL9078	
Project Name:	
Site Location:	
Quote #: 880281	
Sampled By:	

SERVICE REQUESTED:
X RUSH (Contact lab to reserve) Date Required:
O REGULAR (5 to 7 Days)

#	Sample ID	Matrix (GW, SW, Sediment)	Date/Time Sampled YY/MM/DD 24:00	BOD	DOC and low loeve Diss Phosphorus	TOC and low level Total Phosphorus	Nitrogen (total), Calc. TKN, NO3, NO2	Amonia-N (total) and TKN	True Colour	Chl-a	Phenols (4-AAP)	TSS and TDS	Sulphide	Routine Water and Diss regulated metals	Regulated metals (CCME7AT1) - Total	Naphthenic Acids by IR	Hydrocarbon by IR (Mineral oil & grease) - TPHIR	Methyl-mercury (sub)	Untra low level Mercury total and diss. (sub)	B80281	HOLD - Do not Analyze	# of Containers Submitted
1	HZL 1 to 3 Comp.	SW	Sept 6 - 1000																	X		21
2	SP-1	SW	Sept 6 - 1000																	X		21
3	HZL - FB	SW	Sept 6 0950																	X		21
4																						
5																						
6	Received in Fort McMurray																					
7	By: [redacted]																					
8	SEP 06 2018 @																					
9	1:55 pm																					
10	Ice yes cs no																					
11	Temp: 5 7 4 15°C																					
12																						

Please Indicate Filtered, Preserved or Both (F, P, F/P) F/P

Relinquished By (Signature/Print):	Date (YY/MM/DD):	Time (24:00)
[redacted] Aurora Jansen	18/09/06	1355
Relinquished By (Signature/Print):	Date (YY/MM/DD)	Time (24:00)

Special Instructions: NOT FIELD FILTERED
CHLOROPHYLL A NOT FILTERED

# of Jars Used & Not Submitted

LAB USE ONLY

Received By:	Date:	Time:	Maxxam Job #:
[redacted]	~~18/09/06~~ 2018/09/07	07:00	

Custody Seal	Temperature	Ice
Refer	to ACTR	

Lab Comments:

uc

06-Sep-18 13:59

[redacted]

B876287

IL4 INS-0058

DI USED FOR ULTRA TRACE (HZL-FB)
WAS EXPIRED (AUG 2018)
FLETT Hg NOT FROZEN

001748

Methyl Mercury Results

Flett Research Ltd.
440 DeSalaberry Ave Winnipeg, MB R2L 0Y7
Fax/Phone (204) 667-2505
E-mail flett@flettresearch.ca Webpage http //www flettresearch.ca

CLIENT: Maxxam Analytics - Calgary: B876287
4000 - 19th Street NE
Calgary, AB T2E 6P8

Date Received: September 11, 2018
Sampling Date: September 6, 2018

Matrix: Water
Transaction ID: 677
PO/Contract No.:
Date Analysed: September 14, 2018
Analyst(s): Jason S.

Analytical Method: M10211 Methyl Mercury in Water by Distillation, Aqueous Ethylation, Purge and Trap, and CVAFS - Tekran 2700 Mercury Analyser (Version 1)

Comments: Samples HZL 1 TO 3 COMP and SP-1 were yellow in colour with particulates

Detection Limit: 0 08 ng/L (ML) MDL=0 03 ng/L (based on 7 replicates of method blanks with 98% confidence level and the analysis of 45mL of raw sample and 20mL of distillate)
For reporting purpose samples will be flagged below the ML which is considered a practical detection limit

Estimated Uncertainty: The estimated uncertainty of this method has preliminarily been determined to be ± 10 % at methyl mercury concentrations of 0.5 and 2 5 ng/L (95 % confidence). Uncertainty at 0.1 ng/L is 13% (95% confidence)

Results authorized by Dr. Robert J. Flett, Chief Scientist

QUALITY DATA

Blanks		Pg of CH3Hg in the Ethylation Blank	Mean Gross Peak Area	CH3Hg in the Ethylation Blank (ng/L) assumes volume is 30mL
	Ethylation blank (H_20+Reagents)	0 16	14.77	0.005
	Mean Eth. Blank (last 30 runs)	0.16		
		Net Pg CH3Hg in the Method Blank [Eth Blank subtracted]	Gross Peak Area	Net CH3Hg in the Method Blank (ng/L) [Eth Blank subtracted]
	Method Blank 1	0 18	31 54	0.01
	Method Blank 2	0 19	32.28	0 01
	Method Blank 3	0 21	34 59	0 01
	Mean Method Blank			0 01

Mean Calibration Factor (area units / pg)	93.43 ± 5 %RSD

Spike Recovery Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	Sample ID (Details)	Sample Type	Gross Peak Area	Volume of Water Sample Distilled (mL)	% CH_3Hg Recovery Used for Calculations	Net CH_3Hg as Hg (ng/L)	CH_3Hg Recovery (%)	
	UG2400 (SP-1)	MS1	2187.64	47.30	100%	1.03	90.9	
	UG2400 (SP-1)	MS1D	2374.63	47.72	100%	1.05	93.6	%RPD=2.9
	Mean of Spike Recoveries						**92.2**	
QC Samples Ongoing Precision & Recovery (OPR)	MeOPR ID1701 (1000ng/L)	(beginning of run)	2273 19	0 050	100%	972	97.2	
	MeOPR ID1701 (1000ng/L)	(end of run)	2335 08	0 050	100%	975	97 5	
	MeOPR ID1701 (1000ng/L)	(beginning of run)	2283 73	0 050	100%	971	97 1	
	MeOPR ID1701 (1000ng/L)	(end of run)	2268 53	0 050	100%	955	95.5	
	Mean of MeOPR					968	96 8	
Alternate Source Standard (A.S.S)	A.S S -Alfa ID1302 (1000 ng/L)		3898 57		100%	1039	**103.9**	

LAB ID	Sampling Details	Sample ID	Date Sampled	Time Sampled	Sample Type	Gross Peak Area	Volume of Water Sample Distilled (mL)	% CH_3Hg Recovery Used for Calculations	Net CH_3Hg in the Sample as Hg (ng/L) [Ethylation & Method Blank subtracted] [recovery corrected]
90452	UG2399	HZL 1 TO 3 COMP	September 6 2018	10 00	DupA1	154 12	48 51	92 2%	~ 0.06
90452	UG2399	HZL 1 TO 3 COMP.	September 6, 2018	10:00	DupA2	147 29	47.14	92.2%	~ 0.06
90453	UG2400	SP-1	September 6, 2018	10:00		171.48	47.34	92 2%	~ 0.07
90454	UG2401	HZL-FB	September 6, 2018	09:50		24.07	47 66	92.2%	~ 0.00

Q:\Clients M-Z\Maxxam Analytics - Calgary\2018(677)\Methyl Mercury\MTWATR091418JS2.xls

* . See 'Comments' section above for discussion

~ Result below the official detection limit for this analyte in this matrix

Dup Duplicate - two subsamples of the same sample carried through the analytical procedure in an identical manner

Note Results relate only to the items tested

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Your Project #: CNRL9078
Your C.O.C. #: 576776-01-01

Attention: Meghan Isaacs

HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2019/03/08
Report #: R2695474
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B912845
Received: 2019/02/22, 07:00

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	3	N/A	2019/02/25	AB SOP-00005	SM 23 2320 B m
Biochemical Oxygen Demand	3	2019/02/22	2019/02/27	AB SOP-00017	SM 22 5210B m
Cadmium - low level CCME - Dissolved	3	N/A	2019/02/26	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total)	3	N/A	2019/02/27	AB WI-00065	Auto Calc
Chlorophyll A (water)(sin) (1)	3	2019/02/26	2019/02/27	BBY6SOP-00002	SM 23 10200 H m
Chloride by Automated Colourimetry	3	N/A	2019/02/25	AB SOP-00020	SM 22 4500-Cl-E m
True Colour (3)	3	N/A	2019/02/25	CAL SOP-00049	SM 23 2120 C m
Carbon (DOC) -Lab Filtered (4)	3	N/A	2019/02/26	AB SOP-00087	MMCW 119 1996 m
Conductivity @25C	3	N/A	2019/02/25	AB SOP-00005	SM 23 2510 B m
Sulphide (as H2S)	3	N/A	2019/02/25	AB WI-00065	Auto Calc
Hardness	3	N/A	2019/02/26	AB WI-00065	Auto Calc
Mercury by Gold Trap-CVAF Ultra-Low(Dis) (1)	2	N/A	2019/03/07	BBY7SOP-00022	EPA 1631E m
Mercury by Gold Trap-CVAF Ultra-Low(Dis) (1)	1	N/A	2019/03/08	BBY7SOP-00022	EPA 1631E m
Mercury by Gold Trap-CVAF Ultra-Low(Tot) (1)	2	2019/03/05	2019/03/07	BBY7SOP-00022	EPA 1631E m
Mercury by Gold Trap-CVAF Ultra-Low(Tot) (1)	1	2019/03/05	2019/03/08	BBY7SOP-00022	EPA 1631E m
Elements by ICP-Dissolved-Lab Filtered (5)	1	N/A	2019/02/25	AB SOP-00042	EPA 6010d R4 m
Elements by ICP-Dissolved-Lab Filtered (5)	2	N/A	2019/02/26	AB SOP-00042	EPA 6010d R4 m
Elements by ICP - Total	1	2019/02/25	2019/02/25	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICP - Total	2	2019/02/25	2019/02/26	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS-Dissolved-Lab Filtered (6)	3	N/A	2019/02/25	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	3	2019/02/25	2019/02/25	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Ion Balance	3	N/A	2019/02/25	AB WI-00065	Auto Calc
Sum of cations, anions	3	N/A	2019/02/26	AB WI-00065	Auto Calc
Nitrogen (total), Calc. TKN, NO3, NO2	2	N/A	2019/02/26	AB WI-00065	Auto Calc
Nitrogen (total), Calc. TKN, NO3, NO2	1	N/A	2019/02/27	AB WI-00065	Auto Calc
Naphthenic Acids by IR	3	2019/02/22	2019/02/25	AB SOP-00060	EPA 3510C R3 / FTIR
Ammonia-N (Total)	3	N/A	2019/02/25	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate and Nitrite	1	N/A	2019/02/25	AB WI-00065	Auto Calc
Nitrate and Nitrite	1	N/A	2019/02/26	AB WI-00065	Auto Calc

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

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Your Project #: CNRL9078
Your C.O.C. #: 576776-01-01

Attention: Meghan Isaacs

HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2019/03/08
Report #: R2695474
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B912845
Received: 2019/02/22, 07:00

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Nitrate and Nitrite	1	N/A	2019/02/27	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	1	N/A	2019/02/25	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	1	N/A	2019/02/26	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	1	N/A	2019/02/27	AB WI-00065	Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	N/A	2019/02/25	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC	1	N/A	2019/02/27	AB SOP-00023	SM 23 4110 B m
pH @25°C (7)	3	N/A	2019/02/25	AB SOP-00005	SM 23 4500-H+B m
Phenols (4-AAP) (2)	3	N/A	2019/02/27	EENVSOP-00061	MMCW 154 1996 m
Total Sulphide	3	N/A	2019/02/25	AB SOP-00080	SM 23 4500 S2-A D Fm
Sulphate by Automated Colourimetry	3	N/A	2019/02/25	AB SOP-00018	SM 23 4500-SO4 E m
Total Dissolved Solids (Filt. Residue)	3	2019/02/22	2019/02/22	AB SOP-00065	SM 23 2540 C m
Total Dissolved Solids (Calculated)	3	N/A	2019/02/26	AB WI-00065	Auto Calc
Total Kjeldahl Nitrogen	3	2019/02/25	2019/02/26	AB SOP-00008	EPA 351.1 R1978 m
Carbon (Total Organic) (8)	1	N/A	2019/02/27	AB SOP-00087	MMCW 119 1996 m
Carbon (Total Organic) (8)	2	N/A	2019/02/28	AB SOP-00087	MMCW 119 1996 m
Total Phoshphorus-Dis-Low-Lab Filtered	3	2019/02/25	2019/02/26	AB SOP-00024	SM 22 4500-P A,B,F m
Total Phosphorus Low Level Total	3	2019/02/25	2019/02/26	AB SOP-00024	SM 22 4500-P A,B,F m
Hydrocarbon by IR (Mineral oil & grease)	3	2019/02/26	2019/02/26	CAL SOP-00096	SM 23 5520C,F m
Total Suspended Solids (NFR)	3	2019/02/22	2019/02/22	AB SOP-00061	SM 23 2540 D m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise

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Success Through Sc

Your Project #: CNRL9078
Your C.O.C. #: 576776-01-01

Attention: Meghan Isaacs

HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2019/03/08
Report #: R2695474
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B912845
Received: 2019/02/22, 07:00

agreed in writing. Maxxam is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Maxxam Vancouver
(2) This test was performed by Maxxam Edmonton Environmental
(3) Analysis completed within 48h after laboratory receipt to a maximum of five days from sampling is satisfactory for compliance purposes.
(4) DOC present in the sample should be considered as non-purgeable DOC. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(5) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(6) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(7) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Maxxam endeavours to analyze samples as soon as possible after receipt.
(8) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Geraldlyn Gouthro
Client Service Specialist
08 Mar 2019 15:39:29

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Geraldlyn Gouthro, Client Service Specialist
Email: GGouthro@maxxam.ca
Phone# (403)735-2230
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam Job #: B912845
Report Date: 2019/03/08

HATFIELD CONSULTANTS
Client Project #: CNRL9078

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		VG4096			VG4097		VG4098		
Sampling Date		2019/02/21 10:35			2019/02/21 11:06		2019/02/21 11:30		
COC Number		576776-01-01			576776-01-01		576776-01-01		
	UNITS	HZL	RDL	QC Batch	SPLIT	QC Batch	FIELD	RDL	QC Batch
Calculated Parameters									
Anion Sum	meq/L	3.2	N/A	9329087	3.1	9329087	0.0000	N/A	9329087
Cation Sum	meq/L	3.3	N/A	9329087	3.1	9329087	0.011	N/A	9329087
Hardness (CaCO3)	mg/L	140	0.50	9329050	130	9329050	<0.50	0.50	9329050
Ion Balance (% Difference)	%	1.4	N/A	9329086	0.13	9329086	NC	N/A	9329086
Dissolved Nitrate (NO3)	mg/L	0.38	0.044	9329088	0.34	9329088	<0.044	0.044	9329088
Nitrate plus Nitrite (N)	mg/L	0.086	0.014	9329157	0.076	9329157	<0.014	0.014	9329157
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9329088	<0.033	9329088	<0.033	0.033	9329088
Sulphide (as H2S)	mg/L	<0.0020	0.0020	9329154	<0.0020	9329154	<0.0020	0.0020	9329154
Calculated Total Dissolved Solids	mg/L	170	10	9329085	160	9329085	<10	10	9329085
Demand Parameters									
Biochemical Oxygen Demand	mg/L	<2.0	2.0	9329851	<2.0	9329851	<2.0	2.0	9329851
Misc. Inorganics									
Conductivity	uS/cm	310	2.0	9331106	300	9331083	<2.0	2.0	9331083
pH	pH	8.11	N/A	9331102	8.00	9331081	4.97	N/A	9331081
Total Organic Carbon (C)	mg/L	15	0.50	9334220	14	9334220	<0.50	0.50	9332864
Total Dissolved Solids	mg/L	150	10	9329867	100	9329867	<10	10	9329867
Total Suspended Solids	mg/L	1.0	1.0	9329416	1.3	9329416	<1.0	1.0	9329416
Lab Filtered Inorganics									
Dissolved Organic Carbon (C)	mg/L	19 (1)	2.5	9331908	19	9331908	<0.50	0.50	9331908
Low Level Elements									
Dissolved Cadmium (Cd)	ug/L	<0.020	0.020	9329059	<0.020	9329059	<0.020	0.020	9329059
Total Cadmium (Cd)	ug/L	<0.020	0.020	9329150	<0.020	9329150	<0.020	0.020	9329150
Anions									
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9331100	<1.0	9331078	<1.0	1.0	9331078
Alkalinity (Total as CaCO3)	mg/L	120	1.0	9331100	120	9331078	<1.0	1.0	9331078
Bicarbonate (HCO3)	mg/L	150	1.0	9331100	140	9331078	<1.0	1.0	9331078
Carbonate (CO3)	mg/L	<1.0	1.0	9331100	<1.0	9331078	<1.0	1.0	9331078
Hydroxide (OH)	mg/L	<1.0	1.0	9331100	<1.0	9331078	<1.0	1.0	9331078
Dissolved Sulphate (SO4)	mg/L	34	1.0	9331406	33	9331161	<1.0	1.0	9331161
Total Sulphide	mg/L	<0.0019	0.0019	9331025	<0.0019	9331025	<0.0019	0.0019	9331025
Dissolved Chloride (Cl)	mg/L	1.3	1.0	9331404	1.9	9331157	<1.0	1.0	9331157

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to sample matrix.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

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Maxxam Job #: B912845
Report Date: 2019/03/08

HATFIELD CONSULTANTS
Client Project #: CNRL9078

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		VG4096			VG4097		VG4098		
Sampling Date		2019/02/21 10:35			2019/02/21 11:06		2019/02/21 11:30		
COC Number		576776-01-01			576776-01-01		576776-01-01		
	UNITS	HZL	RDL	QC Batch	SPLIT	QC Batch	FIELD	RDL	QC Batch
MISCELLANEOUS									
Chlorophyll a	ug/L	<0.50	0.50	9332282	<0.50	9332282	<0.50	0.50	9332282
Nutrients									
Total Ammonia (N)	mg/L	<0.015	0.015	9331221	<0.015	9331221	<0.015	0.015	9331221
Total Nitrogen (N)	mg/L	0.65	0.055	9329347	0.64	9329347	<0.055	0.055	9329347
Total Phosphorus (P)	mg/L	0.014	0.0010	9331305	0.014	9331305	<0.0010	0.0010	9331305
Total Total Kjeldahl Nitrogen	mg/L	0.56	0.050	9331219	0.57	9331219	<0.050	0.050	9331219
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9332198	<0.010	9331113	<0.010	0.010	9331113
Dissolved Nitrate (N)	mg/L	0.086	0.010	9332198	0.076	9331113	<0.010	0.010	9331113
Lab Filtered Nutrients									
Dissolved Phosphorus (P)	mg/L	0.011	0.0010	9331301	0.0086	9331301	<0.0010	0.0010	9331301
Misc. Organics									
Naphthenic Acids	mg/L	<1.0	1.0	9327878	<1.0	9327878	<1.0	1.0	9327878
Phenols	mg/L	0.0040	0.0020	9333753	0.0041	9333753	<0.0020	0.0020	9333753
Total Petroleum Hydrocarbon	mg/L	<2.0	2.0	9329536	<2.0	9329536	<2.0	2.0	9329536
Physical Properties									
True Colour	PtCo units	35	2.0	9330943	37	9330943	<2.0	2.0	9330943
RDL = Reportable Detection Limit									

MERCURY BY COLD VAPOR (WATER)

Maxxam ID		VG4096	VG4097	VG4098		
Sampling Date		2019/02/21 10:35	2019/02/21 11:06	2019/02/21 11:30		
COC Number		576776-01-01	576776-01-01	576776-01-01		
	UNITS	HZL	SPLIT	FIELD	RDL	QC Batch
Elements						
Dissolved Mercury (Hg)	ng/L	1.1	1.2	3.3	0.10	9339631
Total Mercury (Hg)	ng/L	6.4	0.91	2.7 (1)	0.10	9339637

RDL = Reportable Detection Limit

(1) Duplicate exceeds acceptance criteria due to sample non homogeneity. Reanalysis yields similar results.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		VG4096		VG4097	VG4098		
Sampling Date		2019/02/21 10:35		2019/02/21 11:06	2019/02/21 11:30		
COC Number		576776-01-01		576776-01-01	576776-01-01		
	UNITS	HZL	QC Batch	SPLIT	FIELD	RDL	QC Batch
Elements							
Total Aluminum (Al)	mg/L	0.022	9331077	0.022	<0.0030	0.0030	9331077
Total Antimony (Sb)	mg/L	<0.00060	9331077	<0.00060	<0.00060	0.00060	9331077
Total Arsenic (As)	mg/L	0.00073	9331077	0.00083	<0.00020	0.00020	9331077
Total Barium (Ba)	mg/L	0.034	9331074	0.033	<0.010	0.010	9331074
Total Beryllium (Be)	mg/L	<0.0010	9331077	<0.0010	<0.0010	0.0010	9331077
Total Boron (B)	mg/L	0.056	9331074	0.054	<0.020	0.020	9331074
Total Calcium (Ca)	mg/L	36	9331074	34	<0.30	0.30	9331074
Total Chromium (Cr)	mg/L	<0.0010	9331077	<0.0010	<0.0010	0.0010	9331077
Total Cobalt (Co)	mg/L	<0.00030	9331077	<0.00030	<0.00030	0.00030	9331077
Total Copper (Cu)	mg/L	0.0011	9331077	0.0011	<0.00020	0.00020	9331077
Total Iron (Fe)	mg/L	0.12	9331074	0.11	<0.060	0.060	9331074
Total Lead (Pb)	mg/L	<0.00020	9331077	<0.00020	<0.00020	0.00020	9331077
Total Lithium (Li)	mg/L	<0.020	9331074	<0.020	<0.020	0.020	9331074
Total Magnesium (Mg)	mg/L	11	9331074	10	<0.20	0.20	9331074
Total Manganese (Mn)	mg/L	0.017	9331074	0.017	<0.0040	0.0040	9331074
Total Molybdenum (Mo)	mg/L	0.0014	9331077	0.0013	<0.00020	0.00020	9331077
Total Nickel (Ni)	mg/L	0.0025	9331077	0.0028	<0.00050	0.00050	9331077
Total Phosphorus (P)	mg/L	<0.10	9331074	<0.10	<0.10	0.10	9331074
Total Potassium (K)	mg/L	1.4	9331074	1.4	<0.30	0.30	9331074
Total Selenium (Se)	mg/L	<0.00020	9331077	<0.00020	<0.00020	0.00020	9331077
Total Silicon (Si)	mg/L	0.63	9331074	0.61	<0.10	0.10	9331074
Total Silver (Ag)	mg/L	<0.00010	9331077	<0.00010	<0.00010	0.00010	9331077
Total Sodium (Na)	mg/L	11	9331074	10	<0.50	0.50	9331074
Total Strontium (Sr)	mg/L	0.14	9331074	0.14	<0.020	0.020	9331074
Total Sulphur (S)	mg/L	9.4	9331074	9.1	<0.20	0.20	9331074
Total Thallium (Tl)	mg/L	<0.00020	9331077	<0.00020	<0.00020	0.00020	9331077
Total Tin (Sn)	mg/L	<0.0010	9331077	<0.0010	<0.0010	0.0010	9331077
Total Titanium (Ti)	mg/L	0.0039	9331077	<0.0010	<0.0010	0.0010	9331077
Total Uranium (U)	mg/L	0.00041	9331077	0.00042	<0.00010	0.00010	9331077
Total Vanadium (V)	mg/L	<0.0010	9331077	<0.0010	<0.0010	0.0010	9331077
Total Zinc (Zn)	mg/L	0.0033	9331077	0.0044	<0.0030	0.0030	9331077
Lab Filtered Elements							
Dissolved Aluminum (Al)	mg/L	0.0039	9331008	<0.0030	<0.0030	0.0030	9331008
RDL = Reportable Detection Limit							

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Maxxam Job #: B912845
Report Date: 2019/03/08

HATFIELD CONSULTANTS
Client Project #: CNRL9078

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		VG4096		VG4097	VG4098		
Sampling Date		2019/02/21 10:35		2019/02/21 11:06	2019/02/21 11:30		
COC Number		576776-01-01		576776-01-01	576776-01-01		
	UNITS	HZL	QC Batch	SPLIT	FIELD	RDL	QC Batch
Dissolved Antimony (Sb)	mg/L	<0.00060	9331008	<0.00060	<0.00060	0.00060	9331008
Dissolved Arsenic (As)	mg/L	0.00052	9331008	0.00055	<0.00020	0.00020	9331008
Dissolved Barium (Ba)	mg/L	0.035	9331338	0.032	<0.010	0.010	9331338
Dissolved Beryllium (Be)	mg/L	<0.0010	9331008	<0.0010	<0.0010	0.0010	9331008
Dissolved Boron (B)	mg/L	0.058	9331338	0.060	<0.020	0.020	9331338
Dissolved Calcium (Ca)	mg/L	37	9331338	34	<0.30	0.30	9331338
Dissolved Chromium (Cr)	mg/L	<0.0010	9331008	<0.0010	<0.0010	0.0010	9331008
Dissolved Cobalt (Co)	mg/L	<0.00030	9331008	<0.00030	<0.00030	0.00030	9331008
Dissolved Copper (Cu)	mg/L	0.00051	9336280	0.00078	0.00023	0.00020	9331008
Dissolved Iron (Fe)	mg/L	<0.060	9331338	<0.060	<0.060	0.060	9331338
Dissolved Lead (Pb)	mg/L	<0.00020	9331008	<0.00020	<0.00020	0.00020	9331008
Dissolved Lithium (Li)	mg/L	<0.020	9331338	<0.020	<0.020	0.020	9331338
Dissolved Magnesium (Mg)	mg/L	11	9331338	11	<0.20	0.20	9331338
Dissolved Manganese (Mn)	mg/L	0.012	9331338	0.013	<0.0040	0.0040	9331338
Dissolved Molybdenum (Mo)	mg/L	0.0012	9331008	0.0011	<0.00020	0.00020	9331008
Dissolved Nickel (Ni)	mg/L	0.0027	9331008	0.0023	<0.00050	0.00050	9331008
Dissolved Phosphorus (P)	mg/L	<0.10	9331338	<0.10	<0.10	0.10	9331338
Dissolved Potassium (K)	mg/L	1.5	9331338	1.3	<0.30	0.30	9331338
Dissolved Selenium (Se)	mg/L	<0.00020	9331008	<0.00020	<0.00020	0.00020	9331008
Dissolved Silicon (Si)	mg/L	0.60	9331338	0.62	<0.10	0.10	9331338
Dissolved Silver (Ag)	mg/L	<0.00010	9331008	<0.00010	<0.00010	0.00010	9331008
Dissolved Sodium (Na)	mg/L	11	9331338	11	<0.50	0.50	9331338
Dissolved Strontium (Sr)	mg/L	0.15	9331338	0.14	<0.020	0.020	9331338
Dissolved Sulphur (S)	mg/L	10	9331338	11	<0.20	0.20	9331338
Dissolved Thallium (Tl)	mg/L	<0.00020	9331008	<0.00020	<0.00020	0.00020	9331008
Dissolved Tin (Sn)	mg/L	<0.0010	9331008	<0.0010	<0.0010	0.0010	9331008
Dissolved Titanium (Ti)	mg/L	<0.0010	9331008	<0.0010	<0.0010	0.0010	9331008
Dissolved Uranium (U)	mg/L	0.00037	9331008	0.00057	<0.00010	0.00010	9331008
Dissolved Vanadium (V)	mg/L	<0.0010	9331008	<0.0010	<0.0010	0.0010	9331008
Dissolved Zinc (Zn)	mg/L	0.0050	9331008	<0.0030	<0.0030	0.0030	9331008
RDL = Reportable Detection Limit							

GENERAL COMMENTS

Sample VG4096 [HZL] : Sample was analyzed past method specified hold time for Nitrogen (Nitrite - Nitrate) by IC. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.

RESULTS OF CHEMICAL ANALYSES OF WATER Comments

Sample VG4096 [HZL] Nitrogen (Nitrite - Nitrate) by IC: Sample was originally processed within hold time. Data quality required investigation. Re-analysis was completed past recommended hold time.

Sample VG4096, Elements by ICPMS-Dissolved-Lab Filtered: Test repeated.

Results relate only to the items tested.

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Success Througl

Maxxam Job #: B912845
Report Date: 2019/03/08

HATFIELD CONSULTANTS
Client Project #: CNRL9078

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9327878	LL0	Matrix Spike	Naphthenic Acids	2019/02/25		99	%	70 - 130
9327878	LL0	Spiked Blank	Naphthenic Acids	2019/02/25		94	%	70 - 130
9327878	LL0	Method Blank	Naphthenic Acids	2019/02/25	<1.0		mg/L	
9327878	LL0	RPD	Naphthenic Acids	2019/02/25	NC		%	30
9329416	HE1	Matrix Spike	Total Suspended Solids	2019/02/22		105	%	80 - 120
9329416	HE1	Spiked Blank	Total Suspended Solids	2019/02/22		88	%	80 - 120
9329416	HE1	Method Blank	Total Suspended Solids	2019/02/22	<1.0		mg/L	
9329416	HE1	RPD	Total Suspended Solids	2019/02/22	NC		%	20
9329536	LL0	Spiked Blank	Total Petroleum Hydrocarbon	2019/02/26		102	%	70 - 130
9329536	LL0	Method Blank	Total Petroleum Hydrocarbon	2019/02/26	<2.0		mg/L	
9329851	MWX	Spiked Blank	Biochemical Oxygen Demand	2019/02/27		91	%	85 - 115
9329851	MWX	Method Blank	Biochemical Oxygen Demand	2019/02/27	<2.0		mg/L	
9329851	MWX	RPD	Biochemical Oxygen Demand	2019/02/27	NC		%	20
9329867	HE1	Matrix Spike	Total Dissolved Solids	2019/02/22		101	%	80 - 120
9329867	HE1	Spiked Blank	Total Dissolved Solids	2019/02/22		91	%	80 - 120
9329867	HE1	Method Blank	Total Dissolved Solids	2019/02/22	<10		mg/L	
9329867	HE1	RPD	Total Dissolved Solids	2019/02/22	17		%	20
9330943	MB5	Matrix Spike [VG4097-01]	True Colour	2019/02/25		83	%	80 - 120
9330943	MB5	Spiked Blank	True Colour	2019/02/25		104	%	80 - 120
9330943	MB5	Method Blank	True Colour	2019/02/25	<2.0		PtCo units	
9330943	MB5	RPD [VG4097-01]	True Colour	2019/02/25	0.74		%	20
9331008	ANE	Matrix Spike	Dissolved Aluminum (Al)	2019/02/25		109	%	80 - 120
			Dissolved Antimony (Sb)	2019/02/25		106	%	80 - 120
			Dissolved Arsenic (As)	2019/02/25		100	%	80 - 120
			Dissolved Beryllium (Be)	2019/02/25		97	%	80 - 120
			Dissolved Chromium (Cr)	2019/02/25		95	%	80 - 120
			Dissolved Cobalt (Co)	2019/02/25		92	%	80 - 120
			Dissolved Copper (Cu)	2019/02/25		106	%	80 - 120
			Dissolved Lead (Pb)	2019/02/25		96	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/02/25		103	%	80 - 120
			Dissolved Nickel (Ni)	2019/02/25		94	%	80 - 120
			Dissolved Selenium (Se)	2019/02/25		99	%	80 - 120
			Dissolved Silver (Ag)	2019/02/25		103	%	80 - 120
			Dissolved Thallium (Tl)	2019/02/25		97	%	80 - 120
			Dissolved Tin (Sn)	2019/02/25		100	%	80 - 120
			Dissolved Titanium (Ti)	2019/02/25		90	%	80 - 120
			Dissolved Uranium (U)	2019/02/25		88	%	80 - 120
			Dissolved Vanadium (V)	2019/02/25		102	%	80 - 120
			Dissolved Zinc (Zn)	2019/02/25		107	%	80 - 120
9331008	ANE	Spiked Blank	Dissolved Aluminum (Al)	2019/02/25		104	%	80 - 120
			Dissolved Antimony (Sb)	2019/02/25		105	%	80 - 120
			Dissolved Arsenic (As)	2019/02/25		101	%	80 - 120
			Dissolved Beryllium (Be)	2019/02/25		95	%	80 - 120
			Dissolved Chromium (Cr)	2019/02/25		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/02/25		98	%	80 - 120
			Dissolved Copper (Cu)	2019/02/25		101	%	80 - 120
			Dissolved Lead (Pb)	2019/02/25		96	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/02/25		99	%	80 - 120
			Dissolved Nickel (Ni)	2019/02/25		98	%	80 - 120
			Dissolved Selenium (Se)	2019/02/25		98	%	80 - 120
			Dissolved Silver (Ag)	2019/02/25		101	%	80 - 120
			Dissolved Thallium (Tl)	2019/02/25		96	%	80 - 120
			Dissolved Tin (Sn)	2019/02/25		102	%	80 - 120
			Dissolved Titanium (Ti)	2019/02/25		102	%	80 - 120
			Dissolved Uranium (U)	2019/02/25		94	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Vanadium (V)	2019/02/25		107	%	80 - 120
			Dissolved Zinc (Zn)	2019/02/25		103	%	80 - 120
9331008	ANE	Method Blank	Dissolved Aluminum (Al)	2019/02/25	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/02/25	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/02/25	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/02/25	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/02/25	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/02/25	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/02/25	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/02/25	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/02/25	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/02/25	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/02/25	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/02/25	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2019/02/25	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/02/25	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/02/25	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/02/25	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/02/25	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/02/25	<0.0030		mg/L	
9331008	ANE	RPD	Dissolved Aluminum (Al)	2019/02/25	6.7		%	20
			Dissolved Antimony (Sb)	2019/02/25	NC		%	20
			Dissolved Arsenic (As)	2019/02/25	NC		%	20
			Dissolved Beryllium (Be)	2019/02/25	NC		%	20
			Dissolved Chromium (Cr)	2019/02/25	NC		%	20
			Dissolved Cobalt (Co)	2019/02/25	NC		%	20
			Dissolved Copper (Cu)	2019/02/25	1.9		%	20
			Dissolved Lead (Pb)	2019/02/25	NC		%	20
			Dissolved Molybdenum (Mo)	2019/02/25	17		%	20
			Dissolved Nickel (Ni)	2019/02/25	13		%	20
			Dissolved Selenium (Se)	2019/02/25	NC		%	20
			Dissolved Silver (Ag)	2019/02/25	NC		%	20
			Dissolved Thallium (Tl)	2019/02/25	NC		%	20
			Dissolved Tin (Sn)	2019/02/25	NC		%	20
			Dissolved Titanium (Ti)	2019/02/25	NC		%	20
			Dissolved Uranium (U)	2019/02/25	6.8		%	20
			Dissolved Vanadium (V)	2019/02/25	NC		%	20
			Dissolved Zinc (Zn)	2019/02/25	NC		%	20
9331025	JM0	Spiked Blank	Total Sulphide	2019/02/25		108	%	80 - 120
9331025	JM0	Method Blank	Total Sulphide	2019/02/25	<0.0019		mg/L	
9331025	JM0	RPD	Total Sulphide	2019/02/25	8.7		%	20
9331074	MAP	Matrix Spike	Total Barium (Ba)	2019/02/25		89	%	80 - 120
			Total Boron (B)	2019/02/25		90	%	80 - 120
			Total Calcium (Ca)	2019/02/25		98	%	80 - 120
			Total Iron (Fe)	2019/02/25		99	%	80 - 120
			Total Lithium (Li)	2019/02/25		86	%	80 - 120
			Total Magnesium (Mg)	2019/02/25		93	%	80 - 120
			Total Manganese (Mn)	2019/02/25		96	%	80 - 120
			Total Phosphorus (P)	2019/02/25		93	%	80 - 120
			Total Potassium (K)	2019/02/25		89	%	80 - 120
			Total Silicon (Si)	2019/02/25		96	%	80 - 120
			Total Sodium (Na)	2019/02/25		NC	%	80 - 120
			Total Strontium (Sr)	2019/02/25		89	%	80 - 120
			Total Sulphur (S)	2019/02/25		93	%	80 - 120
9331074	MAP	Spiked Blank	Total Barium (Ba)	2019/02/25		92	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Boron (B)	2019/02/25		92	%	80 - 120
			Total Calcium (Ca)	2019/02/25		99	%	80 - 120
			Total Iron (Fe)	2019/02/25		104	%	80 - 120
			Total Lithium (Li)	2019/02/25		88	%	80 - 120
			Total Magnesium (Mg)	2019/02/25		96	%	80 - 120
			Total Manganese (Mn)	2019/02/25		98	%	80 - 120
			Total Phosphorus (P)	2019/02/25		95	%	80 - 120
			Total Potassium (K)	2019/02/25		90	%	80 - 120
			Total Silicon (Si)	2019/02/25		97	%	80 - 120
			Total Sodium (Na)	2019/02/25		89	%	80 - 120
			Total Strontium (Sr)	2019/02/25		92	%	80 - 120
			Total Sulphur (S)	2019/02/25		96	%	80 - 120
9331074	MAP	Method Blank	Total Barium (Ba)	2019/02/26	<0.010		mg/L	
			Total Boron (B)	2019/02/26	<0.020		mg/L	
			Total Calcium (Ca)	2019/02/26	<0.30		mg/L	
			Total Iron (Fe)	2019/02/26	<0.060		mg/L	
			Total Lithium (Li)	2019/02/26	<0.020		mg/L	
			Total Magnesium (Mg)	2019/02/26	<0.20		mg/L	
			Total Manganese (Mn)	2019/02/26	<0.0040		mg/L	
			Total Phosphorus (P)	2019/02/26	<0.10		mg/L	
			Total Potassium (K)	2019/02/26	<0.30		mg/L	
			Total Silicon (Si)	2019/02/26	<0.10		mg/L	
			Total Sodium (Na)	2019/02/26	<0.50		mg/L	
			Total Strontium (Sr)	2019/02/26	<0.020		mg/L	
			Total Sulphur (S)	2019/02/26	<0.20		mg/L	
9331074	MAP	RPD	Total Barium (Ba)	2019/02/26	1.4		%	20
			Total Boron (B)	2019/02/26	0.42		%	20
			Total Calcium (Ca)	2019/02/26	1.2		%	20
			Total Iron (Fe)	2019/02/26	1.3		%	20
			Total Lithium (Li)	2019/02/26	1.4		%	20
			Total Magnesium (Mg)	2019/02/26	1.0		%	20
			Total Manganese (Mn)	2019/02/26	1.9		%	20
			Total Phosphorus (P)	2019/02/26	2.6		%	20
			Total Potassium (K)	2019/02/26	2.5		%	20
			Total Silicon (Si)	2019/02/26	1.2		%	20
			Total Sodium (Na)	2019/02/26	0.34		%	20
			Total Strontium (Sr)	2019/02/26	1.4		%	20
			Total Sulphur (S)	2019/02/26	1.1		%	20
9331077	ANE	Matrix Spike	Total Aluminum (Al)	2019/02/25		105	%	80 - 120
			Total Antimony (Sb)	2019/02/25		106	%	80 - 120
			Total Arsenic (As)	2019/02/25		105	%	80 - 120
			Total Beryllium (Be)	2019/02/25		99	%	80 - 120
			Total Chromium (Cr)	2019/02/25		103	%	80 - 120
			Total Cobalt (Co)	2019/02/25		104	%	80 - 120
			Total Copper (Cu)	2019/02/25		104	%	80 - 120
			Total Lead (Pb)	2019/02/25		105	%	80 - 120
			Total Molybdenum (Mo)	2019/02/25		106	%	80 - 120
			Total Nickel (Ni)	2019/02/25		104	%	80 - 120
			Total Selenium (Se)	2019/02/25		106	%	80 - 120
			Total Silver (Ag)	2019/02/25		106	%	80 - 120
			Total Thallium (Tl)	2019/02/25		104	%	80 - 120
			Total Tin (Sn)	2019/02/25		109	%	80 - 120
			Total Titanium (Ti)	2019/02/25		105	%	80 - 120
			Total Uranium (U)	2019/02/25		101	%	80 - 120
			Total Vanadium (V)	2019/02/25		106	%	80 - 120

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Maxxam Job #: B912845
Report Date: 2019/03/08

HATFIELD CONSULTANTS
Client Project #: CNRL9078

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Zinc (Zn)	2019/02/25		103	%	80 - 120
9331077	ANE	Spiked Blank	Total Aluminum (Al)	2019/02/25		102	%	80 - 120
			Total Antimony (Sb)	2019/02/25		100	%	80 - 120
			Total Arsenic (As)	2019/02/25		100	%	80 - 120
			Total Beryllium (Be)	2019/02/25		90	%	80 - 120
			Total Chromium (Cr)	2019/02/25		98	%	80 - 120
			Total Cobalt (Co)	2019/02/25		98	%	80 - 120
			Total Copper (Cu)	2019/02/25		99	%	80 - 120
			Total Lead (Pb)	2019/02/25		101	%	80 - 120
			Total Molybdenum (Mo)	2019/02/25		103	%	80 - 120
			Total Nickel (Ni)	2019/02/25		99	%	80 - 120
			Total Selenium (Se)	2019/02/25		101	%	80 - 120
			Total Silver (Ag)	2019/02/25		101	%	80 - 120
			Total Thallium (Tl)	2019/02/25		100	%	80 - 120
			Total Tin (Sn)	2019/02/25		102	%	80 - 120
			Total Titanium (Ti)	2019/02/25		99	%	80 - 120
			Total Uranium (U)	2019/02/25		96	%	80 - 120
			Total Vanadium (V)	2019/02/25		99	%	80 - 120
			Total Zinc (Zn)	2019/02/25		97	%	80 - 120
9331077	ANE	Method Blank	Total Aluminum (Al)	2019/02/26	<0.0030		mg/L	
			Total Antimony (Sb)	2019/02/26	<0.00060		mg/L	
			Total Arsenic (As)	2019/02/26	<0.00020		mg/L	
			Total Beryllium (Be)	2019/02/26	<0.0010		mg/L	
			Total Chromium (Cr)	2019/02/26	<0.0010		mg/L	
			Total Cobalt (Co)	2019/02/26	<0.00030		mg/L	
			Total Copper (Cu)	2019/02/26	<0.00020		mg/L	
			Total Lead (Pb)	2019/02/26	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/02/26	<0.00020		mg/L	
			Total Nickel (Ni)	2019/02/26	<0.00050		mg/L	
			Total Selenium (Se)	2019/02/26	<0.00020		mg/L	
			Total Silver (Ag)	2019/02/26	<0.00010		mg/L	
			Total Thallium (Tl)	2019/02/26	<0.00020		mg/L	
			Total Tin (Sn)	2019/02/26	<0.0010		mg/L	
			Total Titanium (Ti)	2019/02/26	<0.0010		mg/L	
			Total Uranium (U)	2019/02/26	<0.00010		mg/L	
			Total Vanadium (V)	2019/02/26	<0.0010		mg/L	
			Total Zinc (Zn)	2019/02/26	<0.0030		mg/L	
9331077	ANE	RPD	Total Aluminum (Al)	2019/02/25	NC		%	20
			Total Antimony (Sb)	2019/02/25	NC		%	20
			Total Arsenic (As)	2019/02/25	1.9		%	20
			Total Beryllium (Be)	2019/02/25	NC		%	20
			Total Chromium (Cr)	2019/02/25	NC		%	20
			Total Cobalt (Co)	2019/02/25	NC		%	20
			Total Copper (Cu)	2019/02/25	NC		%	20
			Total Lead (Pb)	2019/02/25	NC		%	20
			Total Molybdenum (Mo)	2019/02/25	6.8		%	20
			Total Nickel (Ni)	2019/02/25	NC		%	20
			Total Selenium (Se)	2019/02/25	NC		%	20
			Total Silver (Ag)	2019/02/25	NC		%	20
			Total Thallium (Tl)	2019/02/25	NC		%	20
			Total Tin (Sn)	2019/02/25	NC		%	20
			Total Titanium (Ti)	2019/02/25	NC		%	20
			Total Uranium (U)	2019/02/25	NC		%	20
			Total Vanadium (V)	2019/02/25	19		%	20
			Total Zinc (Zn)	2019/02/25	NC		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9331078	IKO	Spiked Blank	Alkalinity (Total as CaCO3)	2019/02/25		94	%	80 - 120
9331078	IKO	Method Blank	Alkalinity (PP as CaCO3)	2019/02/25	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/02/25	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/02/25	<1.0		mg/L	
			Carbonate (CO3)	2019/02/25	<1.0		mg/L	
			Hydroxide (OH)	2019/02/25	<1.0		mg/L	
9331078	IKO	RPD	Alkalinity (PP as CaCO3)	2019/02/25	NC		%	20
			Alkalinity (Total as CaCO3)	2019/02/25	4.7		%	20
			Bicarbonate (HCO3)	2019/02/25	4.7		%	20
			Carbonate (CO3)	2019/02/25	NC		%	20
			Hydroxide (OH)	2019/02/25	NC		%	20
9331081	IKO	Spiked Blank	pH	2019/02/25		100	%	97 - 103
9331081	IKO	RPD	pH	2019/02/25	0.24		%	N/A
9331083	IKO	Spiked Blank	Conductivity	2019/02/25		100	%	90 - 110
9331083	IKO	Method Blank	Conductivity	2019/02/25	<2.0		uS/cm	
9331083	IKO	RPD	Conductivity	2019/02/25	0.61		%	10
9331100	IKO	Spiked Blank	Alkalinity (Total as CaCO3)	2019/02/25		94	%	80 - 120
9331100	IKO	Method Blank	Alkalinity (PP as CaCO3)	2019/02/25	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/02/25	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/02/25	<1.0		mg/L	
			Carbonate (CO3)	2019/02/25	<1.0		mg/L	
			Hydroxide (OH)	2019/02/25	<1.0		mg/L	
9331100	IKO	RPD	Alkalinity (PP as CaCO3)	2019/02/25	NC		%	20
			Alkalinity (Total as CaCO3)	2019/02/25	0.071		%	20
			Bicarbonate (HCO3)	2019/02/25	0.071		%	20
			Carbonate (CO3)	2019/02/25	NC		%	20
			Hydroxide (OH)	2019/02/25	NC		%	20
9331102	IKO	Spiked Blank	pH	2019/02/25		100	%	97 - 103
9331102	IKO	RPD	pH	2019/02/25	0.054		%	N/A
9331106	IKO	Spiked Blank	Conductivity	2019/02/25		101	%	90 - 110
9331106	IKO	Method Blank	Conductivity	2019/02/25	<2.0		uS/cm	
9331106	IKO	RPD	Conductivity	2019/02/25	0		%	10
9331113	PR6	Matrix Spike [VG4098-01]	Dissolved Nitrite (N)	2019/02/25		107	%	80 - 120
			Dissolved Nitrate (N)	2019/02/25		106	%	80 - 120
9331113	PR6	Spiked Blank	Dissolved Nitrite (N)	2019/02/25		100	%	80 - 120
			Dissolved Nitrate (N)	2019/02/25		100	%	80 - 120
9331113	PR6	Method Blank	Dissolved Nitrite (N)	2019/02/25	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/02/25	<0.010		mg/L	
9331113	PR6	RPD [VG4098-01]	Dissolved Nitrite (N)	2019/02/25	NC		%	20
			Dissolved Nitrate (N)	2019/02/25	NC		%	20
9331157	MB5	Matrix Spike	Dissolved Chloride (Cl)	2019/02/25		NC	%	80 - 120
9331157	MB5	Spiked Blank	Dissolved Chloride (Cl)	2019/02/25		108	%	80 - 120
9331157	MB5	Method Blank	Dissolved Chloride (Cl)	2019/02/25	<1.0		mg/L	
9331157	MB5	RPD	Dissolved Chloride (Cl)	2019/02/25	0.41		%	20
9331161	MB5	Matrix Spike	Dissolved Sulphate (SO4)	2019/02/25		NC	%	80 - 120
9331161	MB5	Spiked Blank	Dissolved Sulphate (SO4)	2019/02/25		100	%	80 - 120
9331161	MB5	Method Blank	Dissolved Sulphate (SO4)	2019/02/25	<1.0		mg/L	
9331161	MB5	RPD	Dissolved Sulphate (SO4)	2019/02/25	0.85		%	20
9331219	JLD	Matrix Spike [VG4096-05]	Total Total Kjeldahl Nitrogen	2019/02/26		102	%	80 - 120
9331219	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2019/02/26		106	%	N/A
9331219	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2019/02/26		116	%	80 - 120
9331219	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2019/02/26	<0.050		mg/L	
9331219	JLD	RPD [VG4096-05]	Total Total Kjeldahl Nitrogen	2019/02/26	2.7		%	20
9331221	JLD	Matrix Spike	Total Ammonia (N)	2019/02/25		NC	%	80 - 120
9331221	JLD	Spiked Blank	Total Ammonia (N)	2019/02/25		100	%	80 - 120

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9331221	JLD	Method Blank	Total Ammonia (N)	2019/02/25	<0.015		mg/L	
9331221	JLD	RPD	Total Ammonia (N)	2019/02/25	0.36		%	20
9331301	JLD	Matrix Spike [VG4098-01]	Dissolved Phosphorus (P)	2019/02/26		99	%	80 - 120
9331301	JLD	QC Standard	Dissolved Phosphorus (P)	2019/02/26		98	%	80 - 120
9331301	JLD	Spiked Blank	Dissolved Phosphorus (P)	2019/02/26		102	%	80 - 120
9331301	JLD	Method Blank	Dissolved Phosphorus (P)	2019/02/26	<0.0010		mg/L	
9331301	JLD	RPD [VG4097-01]	Dissolved Phosphorus (P)	2019/02/26	2.8		%	20
9331305	JLD	Matrix Spike [VG4097-05]	Total Phosphorus (P)	2019/02/26		104	%	80 - 120
9331305	JLD	QC Standard	Total Phosphorus (P)	2019/02/26		96	%	80 - 120
9331305	JLD	Spiked Blank	Total Phosphorus (P)	2019/02/26		101	%	80 - 120
9331305	JLD	Method Blank	Total Phosphorus (P)	2019/02/26	<0.0010		mg/L	
9331305	JLD	RPD [VG4098-05]	Total Phosphorus (P)	2019/02/26	NC		%	20
9331338	FM0	Matrix Spike	Dissolved Barium (Ba)	2019/02/25		85	%	80 - 120
			Dissolved Boron (B)	2019/02/25		88	%	80 - 120
			Dissolved Calcium (Ca)	2019/02/25		NC	%	80 - 120
			Dissolved Iron (Fe)	2019/02/25		92	%	80 - 120
			Dissolved Lithium (Li)	2019/02/25		85	%	80 - 120
			Dissolved Magnesium (Mg)	2019/02/25		92	%	80 - 120
			Dissolved Manganese (Mn)	2019/02/25		90	%	80 - 120
			Dissolved Phosphorus (P)	2019/02/25		97	%	80 - 120
			Dissolved Potassium (K)	2019/02/25		91	%	80 - 120
			Dissolved Silicon (Si)	2019/02/25		87	%	80 - 120
			Dissolved Sodium (Na)	2019/02/25		83	%	80 - 120
			Dissolved Strontium (Sr)	2019/02/25		82	%	80 - 120
			Dissolved Sulphur (S)	2019/02/25		NC	%	80 - 120
9331338	FM0	Spiked Blank	Dissolved Barium (Ba)	2019/02/25		91	%	80 - 120
			Dissolved Boron (B)	2019/02/25		91	%	80 - 120
			Dissolved Calcium (Ca)	2019/02/25		98	%	80 - 120
			Dissolved Iron (Fe)	2019/02/25		100	%	80 - 120
			Dissolved Lithium (Li)	2019/02/25		87	%	80 - 120
			Dissolved Magnesium (Mg)	2019/02/25		97	%	80 - 120
			Dissolved Manganese (Mn)	2019/02/25		96	%	80 - 120
			Dissolved Phosphorus (P)	2019/02/25		94	%	80 - 120
			Dissolved Potassium (K)	2019/02/25		91	%	80 - 120
			Dissolved Silicon (Si)	2019/02/25		95	%	80 - 120
			Dissolved Sodium (Na)	2019/02/25		91	%	80 - 120
			Dissolved Strontium (Sr)	2019/02/25		91	%	80 - 120
			Dissolved Sulphur (S)	2019/02/25		95	%	80 - 120
9331338	FM0	Method Blank	Dissolved Barium (Ba)	2019/02/25	<0.010		mg/L	
			Dissolved Boron (B)	2019/02/25	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/02/25	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/02/25	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/02/25	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/02/25	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/02/25	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/02/25	<0.10		mg/L	
			Dissolved Potassium (K)	2019/02/25	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/02/25	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/02/25	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/02/25	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/02/25	<0.20		mg/L	
9331338	FM0	RPD	Dissolved Barium (Ba)	2019/02/25	0.37		%	20
			Dissolved Boron (B)	2019/02/25	0.58		%	20
			Dissolved Calcium (Ca)	2019/02/25	0.22		%	20
			Dissolved Iron (Fe)	2019/02/25	1.2		%	20

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Lithium (Li)	2019/02/25	0.80		%	20
			Dissolved Magnesium (Mg)	2019/02/25	1.3		%	20
			Dissolved Manganese (Mn)	2019/02/25	0.51		%	20
			Dissolved Phosphorus (P)	2019/02/25	NC		%	20
			Dissolved Potassium (K)	2019/02/25	0.29		%	20
			Dissolved Silicon (Si)	2019/02/25	1.0		%	20
			Dissolved Sodium (Na)	2019/02/25	2.2		%	20
			Dissolved Strontium (Sr)	2019/02/25	0.59		%	20
			Dissolved Sulphur (S)	2019/02/25	1.9		%	20
9331404	MB5	Matrix Spike	Dissolved Chloride (Cl)	2019/02/25		NC	%	80 - 120
9331404	MB5	Spiked Blank	Dissolved Chloride (Cl)	2019/02/25		106	%	80 - 120
9331404	MB5	Method Blank	Dissolved Chloride (Cl)	2019/02/25	<1.0		mg/L	
9331404	MB5	RPD	Dissolved Chloride (Cl)	2019/02/25	0.19		%	20
9331406	MB5	Matrix Spike	Dissolved Sulphate (SO4)	2019/02/25		NC	%	80 - 120
9331406	MB5	Spiked Blank	Dissolved Sulphate (SO4)	2019/02/25		98	%	80 - 120
9331406	MB5	Method Blank	Dissolved Sulphate (SO4)	2019/02/25	<1.0		mg/L	
9331406	MB5	RPD	Dissolved Sulphate (SO4)	2019/02/25	0.24		%	20
9331908	SPM	Matrix Spike	Dissolved Organic Carbon (C)	2019/02/26		110	%	80 - 120
9331908	SPM	Spiked Blank	Dissolved Organic Carbon (C)	2019/02/26		105	%	80 - 120
9331908	SPM	Method Blank	Dissolved Organic Carbon (C)	2019/02/26	<0.50		mg/L	
9331908	SPM	RPD	Dissolved Organic Carbon (C)	2019/02/26	NC		%	20
9332198	PR6	Matrix Spike	Dissolved Nitrite (N)	2019/02/26		101	%	80 - 120
			Dissolved Nitrate (N)	2019/02/26		102	%	80 - 120
9332198	PR6	Spiked Blank	Dissolved Nitrite (N)	2019/02/26		98	%	80 - 120
			Dissolved Nitrate (N)	2019/02/26		99	%	80 - 120
9332198	PR6	Method Blank	Dissolved Nitrite (N)	2019/02/26	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/02/26	<0.010		mg/L	
9332198	PR6	RPD	Dissolved Nitrite (N)	2019/02/26	NC		%	20
			Dissolved Nitrate (N)	2019/02/26	0.67		%	20
9332282	KRA	Spiked Blank	Chlorophyll a	2019/02/27		103	%	80 - 120
9332282	KRA	Method Blank	Chlorophyll a	2019/02/27	<0.50		ug/L	
9332864	SPM	Matrix Spike	Total Organic Carbon (C)	2019/02/27		100	%	80 - 120
9332864	SPM	Spiked Blank	Total Organic Carbon (C)	2019/02/27		97	%	80 - 120
9332864	SPM	Method Blank	Total Organic Carbon (C)	2019/02/27	<0.50		mg/L	
9332864	SPM	RPD	Total Organic Carbon (C)	2019/02/27	NC		%	20
9333753	YY	Matrix Spike	Phenols	2019/02/27		96	%	80 - 120
9333753	YY	Spiked Blank	Phenols	2019/02/27		92	%	80 - 120
9333753	YY	Method Blank	Phenols	2019/02/27	<0.0020		mg/L	
9333753	YY	RPD	Phenols	2019/02/27	NC		%	20
9334220	SPM	Matrix Spike [VG4097-05]	Total Organic Carbon (C)	2019/02/28		NC	%	80 - 120
9334220	SPM	Spiked Blank	Total Organic Carbon (C)	2019/02/28		93	%	80 - 120
9334220	SPM	Method Blank	Total Organic Carbon (C)	2019/02/28	<0.50		mg/L	
9334220	SPM	RPD [VG4097-05]	Total Organic Carbon (C)	2019/02/28	4.1		%	20
9336280	ANE	Matrix Spike	Dissolved Copper (Cu)	2019/03/01		90	%	80 - 120
9336280	ANE	Spiked Blank	Dissolved Copper (Cu)	2019/03/01		99	%	80 - 120
9336280	ANE	Method Blank	Dissolved Copper (Cu)	2019/03/01	<0.00020		mg/L	
9336280	ANE	RPD	Dissolved Copper (Cu)	2019/03/01	NC		%	20
9339631	CJY	Matrix Spike	Dissolved Mercury (Hg)	2019/03/07		78	%	70 - 130
9339631	CJY	QC Standard	Dissolved Mercury (Hg)	2019/03/07		83	%	70 - 130
9339631	CJY	Spiked Blank	Dissolved Mercury (Hg)	2019/03/07		89	%	70 - 130
9339631	CJY	Method Blank	Dissolved Mercury (Hg)	2019/03/07	<0.10		ng/L	
9339631	CJY	RPD	Dissolved Mercury (Hg)	2019/03/07	NC		%	25
9339637	CJY	Matrix Spike [VG4096-11]	Total Mercury (Hg)	2019/03/07		96	%	70 - 130
9339637	CJY	QC Standard	Total Mercury (Hg)	2019/03/07		86	%	70 - 130
9339637	CJY	Spiked Blank	Total Mercury (Hg)	2019/03/07		95	%	70 - 130

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9339637	CJY	Method Blank	Total Mercury (Hg)	2019/03/07	<0.10		ng/L	
9339637	CJY	RPD [VG4098-11]	Total Mercury (Hg)	2019/03/08	29 (1)		%	25

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

Dennis Ngondu, B.Sc., P.Chem., QP, Supervisor, Organics

Harry (Peng) Liang, Senior Analyst

Winnie Au, B.Sc., QP, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam — A Bureau Veritas Group Company

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4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free 800-563-6266 Fax (403) 291-9468 www.maxxam.ca

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CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:		REPORT TO		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#11052 HATFIELD CONSULTANTS	Company Name:	#40263 HATFIELD CONSULTANTS	Quotation #	B80281	Maxxam Job #:	Bottle Order #: 576776
Attention:	ACCOUNTS PAYABLE	Attention:	Meghan Isaacs	P.O. #			
Address:	Suite A, 300 MacKenzie Blvd	Address:	Suite A, 300 MacKenzie Blvd	Project:	CNRL9078	COC #:	Project Manager:
	FORT MCMURRAY AB T9H 4C4		FORT MCMURRAY AB T9H 4C4	Project Name:		C#576776-01-01	Geraldlyn Gouthro
Tel:	(780) 743-4294 Fax	Tel:	(780) 743-4294 Fax	Site #:			
Email:	accounting@hatfieldgroup.com	Email:	[redacted]	Sampled By:			

Regulatory Criteria: ☐ ATI ☐ CCME ☐ Other

Special Instructions: Chemical not Filtered.

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required

Please provide advance notice for rush projects

Regular (Standard) TAT: ☐
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required
Rush Confirmation Number (call lab for #)

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	CNRL 9078 - Water Analysis	# of Bottles	Comments
1		HZL	21/Feb/19	10:35	Co.fl.d		✓		
2		Split	21/Feb/19	11:56			✓		
3		Field	21/Feb/19	11:30	↓		✓		
4									
5									
6									
7									
8									
9									
10									

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
Seamus McGrath	19/02/21	9:41	[redacted]	2019/02/22	07:00		☐	3, 1, 1 / 1, 7, 6	☑ Yes ☐ No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT. FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

22-Feb-19 07:00
Geraldlyn Gouthro
B912845
SBZ INS-0200

Maxxam Analytics International Corporation o/a Maxxam Analytics

Methyl Mercury Results

Flett Research Ltd.
440 DeSalaberry Ave Winnipeg, MB R2L 0Y7
Fax/Phone (204) 667-2505
E-mail flett@flettresearch.ca Webpage http //www flettresearch.ca

CLIENT: Maxxam Analytics - Calgary: B912845
4000 - 19th Street NE
Calgary, AB T2E 6P8
Date Received: February 26 2019
Sampling Date: February 21 2019

Matrix: Water
Transaction ID: 677
PO/Contract No.:
Date Analysed: March 6, 2019
Analyst(s): Jason S.

Analytical Method: M10211 Methyl Mercury in Water by Distillation, Aqueous Ethylation, Purge and Trap, and CVAFS - Tekran 2700 Mercury Analyser (Version 1)
Comments: Samples HZL and SPLIT were yellow in colour with particulates

Detection Limit: 0 08 ng/L (ML) MDL=0 03 ng/L (based on 7 replicates of method blanks with 98% confidence level and the analysis of 45mL of raw sample and 20mL of distillate)
For reporting purpose samples will be flagged below the ML which is considered a practical detection limit

Estimated Uncertainty: The estimated uncertainty of this method has preliminarily been determined to be ± 10 % at methyl mercury concentrations of 0 5 and 2 5 ng/L (95 % confidence) Uncertainty at 0 1 ng/L is 13% (95% confidence)

Results authorized by Dr. Robert J. Flett, Chief Scientist

QUALITY DATA

Blanks		Pg of CH3Hg in the Ethylation Blank	Mean Gross Peak Area	CH3Hg in the Ethylation Blank (ng/L) assumes volume is 30mL
	Ethylation blank (H_2O+Reagents)	0 10	6 79	0 003
	Mean Eth Blank (last 30 runs)	0 10		
		Net Pg CH3Hg in the Method Blank (Eth Blank subtracted)	Gross Peak Area	Net CH3Hg in the Method Blank (ng/L) Eth Blank subtracted
	Method Blank 1	0 06	11 09	0 00
	Method Blank 2	0.08	12 26	0 00
	Method Blank 3	0.07	11 49	0 00
	Mean Method Blank			0 00

Mean Calibration Factor (area units / pg)	69 84 ± 5 9 %RSD

Spike Recovery Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	Sample ID (Details)	Sample Type	Gross Peak Area	Volume of Water Sample Distilled (mL)	% CH_3Hg Recovery Used for Calculations	Net CH_3Hg as Hg (ng/L)	CH_3Hg Recovery (%)	
	VG4096 (HZL)	MS3	1537 13	48 50	100%	0 96	90 5	
	VG4096 (HZL)	MS3D	1862 12	47 30	100%	1 09	100 5	%RPD=10 5
	Mean of Spike Recoveries						**95.5**	
QC Samples Ongoing Precision & Recovery (OPR)	MeOPR ID1701 (1000ng/L)	(beginning of run)	864 40	0 050	100%	970	97 0	
	MeOPR ID1701 (1000ng/L)	(end of run)	845 21	0 050	100%	963	96 3	
	MeOPR ID1701 (1000ng/L)	(beginning of run)	958 42	0 050	100%	945	94 5	
	MeOPR ID1701 (1000ng/L)	(end of run)	953 58	0 050	100%	965	96 5	
	Mean of MeOPR					961	96 1	
Alternate Source Standard (A.S.S)	A.S S -Alfa ID1302 (1000 ng/L)		2785 48		100%	995	**99.5**	

LAB ID	Sampling Details	Sample ID	Date Sampled	Time Sampled	Sample Type	Gross Peak Area	Volume of Water Sample Distilled (mL)	% CH_3Hg Recovery Used for Calculations	Net CH_3Hg in the Sample as Hg (ng/L) [Ethylation & Method Blank subtracted] [recovery corrected]
94180	VG4096	HZL	February 21, 2019	10:35		51 55	47 58	95.5%	**~ 0.03**
94181	VG4097	SPLIT	February 21 2019	11 06	DupA1	57 50	47 33	95 5%	**~ 0.03**
94181	VG4097	SPLIT	February 21, 2019	11.06	DupA2	54 75	47 78	95 5%	**~ 0.03**
94182	VG4098	FIELD	February 21, 2019	11·30		10 65	47 64	95 5%	**~ 0.00**

Q:\Clients M-Z\Maxxam Analytics - Calgary\2019(677)\Methyl Mercury\MTWATR030619JS2 xls

* See 'Comments' section above for discussion

~ : Result below the official detection limit for this analyte in this matrix

Dup Duplicate - two subsamples of the same sample carried through the analytical procedure in an identical manner

Note Results relate only to the items tested.

Appendix A10

Sediment Quality Data

Maxxam
A Bureau Veritas Group Company

Your Project #: CNRL9078
Your C.O.C. #: 1 OF 1

Attention: Meghan Isaacs

HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2018/10/15
Report #: R2634898
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B876673
Received: 2018/09/06, 13:55

Sample Matrix: Sediment
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Boron (Hot Water Soluble)	4	2018/09/10	2018/09/10	AB SOP-00034 / AB SOP-00042	EPA 6010d R4 m
BTEX/F1 by HS GC/MS/FID (MeOH extract) (2)	4	N/A	2018/09/09	AB SOP-00039	CCME CWS/EPA 8260d m
F1-BTEX	4	N/A	2018/09/10	AB SOP-00039	Auto Calc
Hexavalent Chromium (3)	4	2018/09/10	2018/09/10	AB SOP-00063	SM 23 3500-Cr B m
Organic Carbon in Soil - Combustion	10	N/A	2018/09/18	CAL SOP-00263	AN-A-030609-E-01 m
CCME Hydrocarbons (F2-F4 in soil) (4)	4	2018/09/08	2018/09/09	AB SOP-00036	CCME PHC-CWS m
Elements by ICPMS (total) (1)	4	2018/10/09	2018/10/09	BBY7SOP-00004 / BBY7SOP-00001	EPA 6020b R2 m
Elements by ICPMS - Soils	4	2018/09/10	2018/09/10	AB SOP-00001 / AB SOP-00043	EPA 6020b R2 m
Moisture	10	N/A	2018/09/09	AB SOP-00002	CCME PHC-CWS m
pH @25C (1:2 Calcium Chloride Extract)	4	2018/09/10	2018/09/10	AB SOP-00033 / AB SOP-00006	SM 22 4500 H+B m
pH (2:1 DI Water Extract) (1)	4	2018/10/09	2018/10/09	BBY6SOP-00028	BCMOE BCLM Mar2005 m
Soluble Ions	4	2018/09/10	2018/09/10	AB SOP-00033 / AB SOP-00042	EPA 6010d R4 m
Soluble Paste	4	2018/09/10	2018/09/10	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Boron Calculation	4	N/A	2018/09/10	AB WI-00065	Auto Calc
Texture by Hydrometer	10	N/A	2018/09/10	AB SOP-00030	Carter 2nd ed 55.3 m
Texture Class	10	N/A	2018/09/10	AB WI-00065	Auto Calc

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed

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Success Through Sc

Your Project #: CNRL9078
Your C.O.C. #: 1 OF 1

Attention: Meghan Isaacs

HATFIELD CONSULTANTS
Suite A, 300 MacKenzie Blvd
FORT MCMURRAY, AB
CANADA T9H 4C4

Report Date: 2018/10/15
Report #: R2634898
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B876673
Received: 2018/09/06, 13:55

or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing. Maxxam is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Vancouver
(2) No lab extraction date is given for F1BTEX & VOC samples that are field preserved with methanol. Extraction date is date sampled unless otherwise stated.
(3) Some soil samples may react with the Cr(VI) spike reducing it to Cr(III). These samples are highly unlikely to contain native hexavalent chromium. Thus a failed spike recovery does not invalidate a negative result on the native sample.
(4) All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Geraldlyn Gouthro
Client Service Specialist
15 Oct 2018 16:44:02

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Geraldlyn Gouthro, Client Service Specialist
Email: GGouthro@maxxam.ca
Phone# (403)735-2230
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF CHEMICAL ANALYSES OF SEDIMENT

Maxxam ID		UG4388		UG4389		UG4390			UG4391		
Sampling Date		2018/09/04 15:05		2018/09/05 09:57		2018/09/05 15:10			2018/09/04 15:55		
COC Number		1 OF 1		1 OF 1		1 OF 1			1 OF 1		
	UNITS	BEN-1	RDL	BEN-2	RDL	BEN-3	RDL	QC Batch	BEN-4	RDL	QC Batch
Calculated Parameters											
Calculated Boron (B)	mg/kg	0.32	0.079	0.38	0.072	0.69	0.078	9134714			
Elements											
Soluble (Hot water) Boron (B)	mg/kg	1.8	0.10	1.8	0.10	2.9	0.10	9135665			
Hex. Chromium (Cr 6+)	mg/kg	<0.080	0.080	<0.080	0.080	<0.080	0.080	9136039			
Misc. Inorganics											
Total Organic Carbon (C)	%	3.2	0.050	2.0	0.050	2.3	0.050	9147257	7.1	0.050	9147257
Physical Properties											
Soluble (2:1) pH	pH	6.62	N/A	6.59	N/A	5.87	N/A	9176170			
Soluble Parameters											
Soluble Boron (B)	mg/L	0.41	0.10	0.53	0.10	0.89	0.10	9136349			
Soluble (CaCl2) pH	pH	6.28	N/A	6.29	N/A	5.97	N/A	9135511			
Saturation %	%	79	N/A	72	N/A	78	N/A	9135408			

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam ID		UG4392	UG4393	UG4394	UG4395	UG4396		
Sampling Date		2018/09/05 13:10	2018/09/05 15:50	2018/09/05 11:40	2018/09/05 12:25	2018/09/05 16:30		
COC Number		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1		
	UNITS	BEN-5	BEN-6	BEN-7	BEN-8	BEN-9	RDL	QC Batch
Misc. Inorganics								
Total Organic Carbon (C)	%	<0.050	2.8	3.1	<0.050	<0.050	0.050	9147257

RDL = Reportable Detection Limit

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Report Date: 2018/10/15

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RESULTS OF CHEMICAL ANALYSES OF SEDIMENT

Maxxam ID		UG4397		
Sampling Date		2018/09/05 10:20		
COC Number		1 OF 1		
	UNITS	SSP-1	RDL	QC Batch
Calculated Parameters				
Calculated Boron (B)	mg/kg	0.19	0.046	9134714
Elements				
Soluble (Hot water) Boron (B)	mg/kg	1.1	0.10	9135665
Hex. Chromium (Cr 6+)	mg/kg	<0.080	0.080	9136039
Misc. Inorganics				
Total Organic Carbon (C)	%	0.20	0.050	9147257
Physical Properties				
Soluble (2:1) pH	pH	6.99	N/A	9176170
Soluble Parameters				
Soluble Boron (B)	mg/L	0.41	0.10	9136349
Soluble (CaCl2) pH	pH	6.63	N/A	9135511
Saturation %	%	46	N/A	9135408
RDL = Reportable Detection Limit				
N/A = Not Applicable				

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Maxxam Job #: B876673
Report Date: 2018/10/15

HATFIELD CONSULTANTS
Client Project #: CNRL9078

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		UG4388		UG4389		UG4390		UG4397		
Sampling Date		2018/09/04 15:05		2018/09/05 09:57		2018/09/05 15:10		2018/09/05 10:20		
COC Number		1 OF 1		1 OF 1		1 OF 1		1 OF 1		
	UNITS	BEN-1	RDL	BEN-2	RDL	BEN-3	RDL	SSP-1	RDL	QC Batch
Ext. Pet. Hydrocarbon										
F2 (C10-C16 Hydrocarbons)	mg/kg	<24 (1)	24	<31 (1)	31	<35 (1)	35	<10	10	9135090
F3 (C16-C34 Hydrocarbons)	mg/kg	<120 (1)	120	170 (1)	160	230 (1)	180	89	50	9135090
F4 (C34-C50 Hydrocarbons)	mg/kg	<120 (1)	120	<160 (1)	160	<180 (1)	180	<50	50	9135090
Reached Baseline at C50	mg/kg	Yes		Yes		Yes		Yes		9135090
Surrogate Recovery (%)										
O-TERPHENYL (sur.)	%	95		106		99		96		9135090

RDL = Reportable Detection Limit
(1) Detection limits raised due to high moisture content, sample contains => 50% moisture.

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Report Date: 2018/10/15

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Client Project #: CNRL9078

PHYSICAL TESTING (SEDIMENT)

Maxxam ID		UG4388	UG4389	UG4390	UG4391	UG4392	UG4393		
Sampling Date		2018/09/04 15:05	2018/09/05 09:57	2018/09/05 15:10	2018/09/04 15:55	2018/09/05 13:10	2018/09/05 15:50		
COC Number		1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1	1 OF 1		
	UNITS	BEN-1	BEN-2	BEN-3	BEN-4	BEN-5	BEN-6	RDL	QC Batch
Physical Properties									
% sand by hydrometer	%	11	16	15	47	59	57	2.0	9135642
% silt by hydrometer	%	59	35	32	36	20	19	2.0	9135642
Clay Content	%	29	49	53	16	21	23	2.0	9135642
Texture	N/A	SLTY CL LO	CLAY	CLAY	LOAM	SNDY CL LO	SNDY CL LO	N/A	9134716
Moisture	%	59	68	72	66	33	29	0.30	9134879

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam ID		UG4394	UG4395	UG4396	UG4397		
Sampling Date		2018/09/05 11:40	2018/09/05 12:25	2018/09/05 16:30	2018/09/05 10:20		
COC Number		1 OF 1	1 OF 1	1 OF 1	1 OF 1		
	UNITS	BEN-7	BEN-8	BEN-9	SSP-1	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	55	87	90	49	2.0	9135642
% silt by hydrometer	%	23	10	6.8	23	2.0	9135642
Clay Content	%	23	2.3	3.1	29	2.0	9135642
Texture	N/A	SNDY CL LO	SAND	SAND	SNDY CL LO	N/A	9134716
Moisture	%	54	43	32	47	0.30	9134879

RDL = Reportable Detection Limit
N/A = Not Applicable

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Report Date: 2018/10/15

HATFIELD CONSULTANTS
Client Project #: CNRL9078

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Maxxam ID		UG4388	UG4389	UG4390	UG4397		
Sampling Date		2018/09/04 15:05	2018/09/05 09:57	2018/09/05 15:10	2018/09/05 10:20		
COC Number		1 OF 1	1 OF 1	1 OF 1	1 OF 1		
	UNITS	BEN-1	BEN-2	BEN-3	SSP-1	RDL	QC Batch
Elements							
Total Antimony (Sb)	mg/kg	<0.50	<0.50	<0.50	<0.50	0.50	9135581
Total Arsenic (As)	mg/kg	13	11	14	7.7	1.0	9135581
Total Barium (Ba)	mg/kg	230	220	260	120	1.0	9135581
Total Beryllium (Be)	mg/kg	0.77	0.83	0.88	0.50	0.40	9135581
Total Cadmium (Cd)	mg/kg	0.42	0.36	0.39	0.23	0.050	9135581
Total Chromium (Cr)	mg/kg	15	23	22	14	1.0	9135581
Total Cobalt (Co)	mg/kg	9.5	11	11	8.5	0.50	9135581
Total Copper (Cu)	mg/kg	20	21	23	17	1.0	9135581
Total Lead (Pb)	mg/kg	12	13	15	7.8	0.50	9135581
Total Mercury (Hg)	mg/kg	0.091	0.093	0.093	0.067	0.050	9135581
Total Molybdenum (Mo)	mg/kg	1.4	1.2	1.6	0.75	0.40	9135581
Total Nickel (Ni)	mg/kg	24	28	28	20	1.0	9135581
Total Selenium (Se)	mg/kg	1.1	0.70	0.94	<0.50	0.50	9135581
Total Silver (Ag)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.20	9135581
Total Thallium (Tl)	mg/kg	0.23	0.23	0.24	0.12	0.10	9135581
Total Tin (Sn)	mg/kg	<1.0	<1.0	<1.0	<1.0	1.0	9135581
Total Uranium (U)	mg/kg	1.4	1.2	1.3	0.86	0.20	9135581
Total Vanadium (V)	mg/kg	26	32 (1)	34	23	1.0	9135581
Total Zinc (Zn)	mg/kg	88	89	95	63	10	9135581
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	10400	11800	13800	9850	100	9176169
Total Antimony (Sb)	mg/kg	0.50	0.47	0.52	0.37	0.10	9176169
Total Arsenic (As)	mg/kg	13.7	12.6	13.9	9.70	0.50	9176169
Total Barium (Ba)	mg/kg	254	244	290	157	0.10	9176169
Total Beryllium (Be)	mg/kg	0.77	0.75	0.98	0.60	0.20	9176169
Total Bismuth (Bi)	mg/kg	0.24	0.26	0.32	0.15	0.10	9176169
Total Boron (B)	mg/kg	15.8	14.9	19.9	15.7	1.0	9176169
Total Cadmium (Cd)	mg/kg	0.431	0.399	0.382	0.249	0.050	9176169
Total Calcium (Ca)	mg/kg	5650	5340	5730	4360	100	9176169
Total Chromium (Cr)	mg/kg	18.9	25.5	23.4	20.2	1.0	9176169
Total Cobalt (Co)	mg/kg	9.94	11.7	11.8	9.82	0.30	9176169

RDL = Reportable Detection Limit

(1) Matrix Spike exceeds acceptance limits due to matrix interference. Reanalysis yields similar results.

ELEMENTS BY ATOMIC SPECTROSCOPY (SEDIMENT)

Maxxam ID		UG4388	UG4389	UG4390	UG4397		
Sampling Date		2018/09/04 15:05	2018/09/05 09:57	2018/09/05 15:10	2018/09/05 10:20		
COC Number		1 OF 1	1 OF 1	1 OF 1	1 OF 1		
	UNITS	BEN-1	BEN-2	BEN-3	SSP-1	RDL	QC Batch
Total Copper (Cu)	mg/kg	19.7	20.7	23.8	17.2	0.50	9176169
Total Iron (Fe)	mg/kg	29000	29300	34500	22600	100	9176169
Total Lead (Pb)	mg/kg	13.4	14.8	17.4	9.45	0.10	9176169
Total Lithium (Li)	mg/kg	15.8	17.6	21.1	16.7	5.0	9176169
Total Magnesium (Mg)	mg/kg	3380	4140	4330	3720	100	9176169
Total Manganese (Mn)	mg/kg	704	686	701	511	0.20	9176169
Total Mercury (Hg)	mg/kg	0.072	0.073	0.079	<0.050	0.050	9176169
Total Molybdenum (Mo)	mg/kg	1.45	1.29	1.71	0.77	0.10	9176169
Total Nickel (Ni)	mg/kg	24.7	27.6	28.1	22.0	0.80	9176169
Total Phosphorus (P)	mg/kg	1070	1070	1360	801	10	9176169
Total Potassium (K)	mg/kg	1750	1970	2340	1530	100	9176169
Total Selenium (Se)	mg/kg	1.06	0.82	0.99	<0.50	0.50	9176169
Total Silver (Ag)	mg/kg	0.134	0.122	0.139	0.075	0.050	9176169
Total Sodium (Na)	mg/kg	122	144	188	103	100	9176169
Total Strontium (Sr)	mg/kg	65.7	68.3	78.5	43.8	0.10	9176169
Total Thallium (Tl)	mg/kg	0.263	0.258	0.288	0.160	0.050	9176169
Total Tin (Sn)	mg/kg	0.58	0.62	0.72	0.50	0.10	9176169
Total Titanium (Ti)	mg/kg	38.8	30.2	31.8	46.4	1.0	9176169
Total Tungsten (W)	mg/kg	<0.50	<0.50	<0.50	<0.50	0.50	9176169
Total Uranium (U)	mg/kg	1.55	1.32	1.55	1.02	0.050	9176169
Total Vanadium (V)	mg/kg	34.8	37.6	42.1	34.8	2.0	9176169
Total Zinc (Zn)	mg/kg	92.1	92.8	98.2	69.8	1.0	9176169
Total Zirconium (Zr)	mg/kg	5.49	7.37	8.54	6.26	0.50	9176169
RDL = Reportable Detection Limit							

VOLATILE ORGANICS BY GC-MS (SEDIMENT)

Maxxam ID		UG4388		UG4389		UG4390		UG4397		
Sampling Date		2018/09/04 15:05		2018/09/05 09:57		2018/09/05 15:10		2018/09/05 10:20		
COC Number		1 OF 1		1 OF 1		1 OF 1		1 OF 1		
	UNITS	BEN-1	RDL	BEN-2	RDL	BEN-3	RDL	SSP-1	RDL	QC Batch
Volatiles										
Xylenes (Total)	mg/kg	<0.13	0.13	<0.17	0.17	<0.21	0.21	<0.045	0.045	9134707
F1 (C6-C10) - BTEX	mg/kg	<24	24	<31	31	<35	35	<10	10	9134707
Field Preserved Volatiles										
Benzene	mg/kg	<0.0080 (1)	0.0080	<0.011 (1)	0.011	<0.012 (1)	0.012	<0.0050	0.0050	9134818
Toluene	mg/kg	<0.056 (2)	0.056	<0.076 (2)	0.076	<0.092 (2)	0.092	<0.020	0.020	9134818
Ethylbenzene	mg/kg	<0.010 (1)	0.010	<0.012 (1)	0.012	<0.013 (1)	0.013	<0.010	0.010	9134818
m & p-Xylene	mg/kg	<0.11 (2)	0.11	<0.15 (2)	0.15	<0.18 (2)	0.18	<0.040	0.040	9134818
o-Xylene	mg/kg	<0.056 (2)	0.056	<0.076 (2)	0.076	<0.092 (2)	0.092	<0.020	0.020	9134818
F1 (C6-C10)	mg/kg	<24 (1)	24	<31 (1)	31	<35 (1)	35	<10	10	9134818
Surrogate Recovery (%)										
1,4-Difluorobenzene (sur.)	%	95		99		99		99		9134818
4-Bromofluorobenzene (sur.)	%	99		100		101		99		9134818
D10-o-Xylene (sur.)	%	86		71		95		89		9134818
D4-1,2-Dichloroethane (sur.)	%	85		80		82		78		9134818

RDL = Reportable Detection Limit

(1) Detection limits calculated based on method detection limits (MDLs) due to high moisture content, sample contains => 50% moisture.

(2) Detection limits raised due to high moisture content, sample contains => 50% moisture.

GENERAL COMMENTS

Revsied Report: Metals updated to match 2017 submission.

Sample UG4388 [BEN-1] : SLTY CL LO = SILTY CLAY LOAM

Sample UG4392 [BEN-5] : SNDY CL LO = SANDY CLAY LOAM

Sample UG4393 [BEN-6] : SNDY CL LO = SANDY CLAY LOAM

Sample UG4394 [BEN-7] : SNDY CL LO = SANDY CLAY LOAM

Sample UG4397 [SSP-1] : SNDY CL LO = SANDY CLAY LOAM

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9134818	SAW	Matrix Spike [UG4388-03]	1,4-Difluorobenzene (sur.)	2018/09/09		98	%	50 - 140
			4-Bromofluorobenzene (sur.)	2018/09/09		96	%	50 - 140
			D10-o-Xylene (sur.)	2018/09/09		102	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2018/09/09		82	%	50 - 140
			Benzene	2018/09/09		87	%	50 - 140
			Toluene	2018/09/09		91	%	50 - 140
			Ethylbenzene	2018/09/09		93	%	50 - 140
			m & p-Xylene	2018/09/09		98	%	50 - 140
			o-Xylene	2018/09/09		93	%	50 - 140
			F1 (C6 C10)	2018/09/09		104	%	60 - 140
9134818	SAW	Spiked Blank	1,4-Difluorobenzene (sur.)	2018/09/09		97	%	50 - 140
			4-Bromofluorobenzene (sur.)	2018/09/09		96	%	50 - 140
			D10-o-Xylene (sur.)	2018/09/09		84	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2018/09/09		82	%	50 - 140
			Benzene	2018/09/09		76	%	60 - 130
			Toluene	2018/09/09		88	%	60 - 130
			Ethylbenzene	2018/09/09		91	%	60 - 130
			m & p-Xylene	2018/09/09		97	%	60 - 130
			o-Xylene	2018/09/09		89	%	60 - 130
			F1 (C6-C10)	2018/09/09		107	%	60 - 140
9134818	SAW	Method Blank	1,4-Difluorobenzene (sur.)	2018/09/09		95	%	50 - 140
			4-Bromofluorobenzene (sur.)	2018/09/09		99	%	50 - 140
			D10-o-Xylene (sur.)	2018/09/09		67	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2018/09/09		89	%	50 - 140
			Benzene	2018/09/09	<0.0050		mg/kg	
			Toluene	2018/09/09	<0.020		mg/kg	
			Ethylbenzene	2018/09/09	<0.010		mg/kg	
			m & p-Xylene	2018/09/09	<0.040		mg/kg	
			o-Xylene	2018/09/09	<0.020		mg/kg	
			F1 (C6-C10)	2018/09/09	<10		mg/kg	
9134818	SAW	RPD [UG4388-03]	Benzene	2018/09/09	NC		%	50
			Toluene	2018/09/09	NC		%	50
			Ethylbenzene	2018/09/09	NC		%	50
			m & p-Xylene	2018/09/09	NC		%	50
			o-Xylene	2018/09/09	NC		%	50
			F1 (C6-C10)	2018/09/09	NC		%	30
9134879	AKX	Method Blank	Moisture	2018/09/09	<0.30		%	
9134879	AKX	RPD [UG4390-02]	Moisture	2018/09/09	0.28		%	20
9135090	MHF	Matrix Spike [UG4397-02]	O-TERPHENYL (sur.)	2018/09/09		100	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2018/09/09		103	%	60 - 140
			F3 (C16-C34 Hydrocarbons)	2018/09/09		97	%	60 - 140
			F4 (C34-C50 Hydrocarbons)	2018/09/09		95	%	60 - 140
9135090	MHF	Spiked Blank	O-TERPHENYL (sur.)	2018/09/09		101	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2018/09/09		104	%	60 - 140
			F3 (C16-C34 Hydrocarbons)	2018/09/09		99	%	60 - 140
			F4 (C34-C50 Hydrocarbons)	2018/09/09		99	%	60 - 140
9135090	MHF	Method Blank	O-TERPHENYL (sur.)	2018/09/09		97	%	60 - 140
			F2 (C10-C16 Hydrocarbons)	2018/09/09	<10		mg/kg	
			F3 (C16-C34 Hydrocarbons)	2018/09/09	<50		mg/kg	
			F4 (C34-C50 Hydrocarbons)	2018/09/09	<50		mg/kg	
9135090	MHF	RPD [UG4397-02]	F2 (C10-C16 Hydrocarbons)	2018/09/09	NC		%	40
			F3 (C16-C34 Hydrocarbons)	2018/09/09	NC		%	40
			F4 (C34-C50 Hydrocarbons)	2018/09/09	NC		%	40
9135408	EH2	QC Standard	Saturation %	2018/09/10		98	%	75 - 125
9135408	EH2	RPD	Saturation %	2018/09/10	2.0		%	12

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Report Date: 2018/10/15

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Client Project #: CNRL9078

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9135511	RCT	QC Standard	Soluble (CaCl2) pH	2018/09/10		100	%	98 - 102
9135511	RCT	Spiked Blank	Soluble (CaCl2) pH	2018/09/10		100	%	97 - 103
9135511	RCT	RPD [UG4389-01]	Soluble (CaCl2) pH	2018/09/10	0.80		%	N/A
9135581	PC5	Matrix Spike [UG4389-01]	Total Antimony (Sb)	2018/09/10		78	%	75 - 125
			Total Arsenic (As)	2018/09/10		88	%	75 - 125
			Total Barium (Ba)	2018/09/10		NC	%	75 - 125
			Total Beryllium (Be)	2018/09/10		93	%	75 - 125
			Total Cadmium (Cd)	2018/09/10		90	%	75 - 125
			Total Chromium (Cr)	2018/09/10		115	%	75 - 125
			Total Cobalt (Co)	2018/09/10		90	%	75 - 125
			Total Copper (Cu)	2018/09/10		86	%	75 - 125
			Total Lead (Pb)	2018/09/10		89	%	75 - 125
			Total Mercury (Hg)	2018/09/10		87	%	75 - 125
			Total Molybdenum (Mo)	2018/09/10		91	%	75 - 125
			Total Nickel (Ni)	2018/09/10		88	%	75 - 125
			Total Selenium (Se)	2018/09/10		87	%	75 - 125
			Total Silver (Ag)	2018/09/10		92	%	75 - 125
			Total Thallium (Tl)	2018/09/10		87	%	75 - 125
			Total Tin (Sn)	2018/09/10		95	%	75 - 125
			Total Uranium (U)	2018/09/10		85	%	75 - 125
			Total Vanadium (V)	2018/09/10		150 (1)	%	75 - 125
			Total Zinc (Zn)	2018/09/10		NC	%	75 - 125
9135581	PC5	QC Standard	Total Arsenic (As)	2018/09/10		95	%	53 - 147
			Total Barium (Ba)	2018/09/10		96	%	80 - 119
			Total Chromium (Cr)	2018/09/10		83	%	59 - 141
			Total Cobalt (Co)	2018/09/10		87	%	58 - 142
			Total Copper (Cu)	2018/09/10		92	%	83 - 117
			Total Lead (Pb)	2018/09/10		102	%	79 - 121
			Total Nickel (Ni)	2018/09/10		96	%	79 - 121
			Total Vanadium (V)	2018/09/10		89	%	79 - 121
			Total Zinc (Zn)	2018/09/10		92	%	79 - 121
9135581	PC5	Spiked Blank	Total Antimony (Sb)	2018/09/10		97	%	80 - 120
			Total Arsenic (As)	2018/09/10		98	%	80 - 120
			Total Barium (Ba)	2018/09/10		101	%	80 - 120
			Total Beryllium (Be)	2018/09/10		99	%	80 - 120
			Total Cadmium (Cd)	2018/09/10		96	%	80 - 120
			Total Chromium (Cr)	2018/09/10		97	%	80 - 120
			Total Cobalt (Co)	2018/09/10		98	%	80 - 120
			Total Copper (Cu)	2018/09/10		97	%	80 - 120
			Total Lead (Pb)	2018/09/10		96	%	80 - 120
			Total Mercury (Hg)	2018/09/10		104	%	80 - 120
			Total Molybdenum (Mo)	2018/09/10		98	%	80 - 120
			Total Nickel (Ni)	2018/09/10		95	%	80 - 120
			Total Selenium (Se)	2018/09/10		96	%	80 - 120
			Total Silver (Ag)	2018/09/10		97	%	80 - 120
			Total Thallium (Tl)	2018/09/10		98	%	80 - 120
			Total Tin (Sn)	2018/09/10		99	%	80 - 120
			Total Uranium (U)	2018/09/10		97	%	80 - 120
			Total Vanadium (V)	2018/09/10		97	%	80 - 120
			Total Zinc (Zn)	2018/09/10		95	%	80 - 120
9135581	PC5	Method Blank	Total Antimony (Sb)	2018/09/10	<0.50		mg/kg	
			Total Arsenic (As)	2018/09/10	<1.0		mg/kg	
			Total Barium (Ba)	2018/09/10	<1.0		mg/kg	
			Total Beryllium (Be)	2018/09/10	<0.40		mg/kg	
			Total Cadmium (Cd)	2018/09/10	<0.050		mg/kg	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Chromium (Cr)	2018/09/10	<1.0		mg/kg	
			Total Cobalt (Co)	2018/09/10	<0.50		mg/kg	
			Total Copper (Cu)	2018/09/10	<1.0		mg/kg	
			Total Lead (Pb)	2018/09/10	<0.50		mg/kg	
			Total Mercury (Hg)	2018/09/10	<0.050		mg/kg	
			Total Molybdenum (Mo)	2018/09/10	<0.40		mg/kg	
			Total Nickel (Ni)	2018/09/10	<1.0		mg/kg	
			Total Selenium (Se)	2018/09/10	<0.50		mg/kg	
			Total Silver (Ag)	2018/09/10	<0.20		mg/kg	
			Total Thallium (Tl)	2018/09/10	<0.10		mg/kg	
			Total Tin (Sn)	2018/09/10	<1.0		mg/kg	
			Total Uranium (U)	2018/09/10	<0.20		mg/kg	
			Total Vanadium (V)	2018/09/10	<1.0		mg/kg	
			Total Zinc (Zn)	2018/09/10	<10		mg/kg	
9135581	PC5	RPD [UG4389-01]	Total Antimony (Sb)	2018/09/10	NC		%	30
			Total Arsenic (As)	2018/09/10	5.7		%	30
			Total Barium (Ba)	2018/09/10	2.8		%	35
			Total Beryllium (Be)	2018/09/10	5.4		%	30
			Total Cadmium (Cd)	2018/09/10	0.25		%	30
			Total Chromium (Cr)	2018/09/10	0.28		%	30
			Total Cobalt (Co)	2018/09/10	2.2		%	30
			Total Copper (Cu)	2018/09/10	2.3		%	30
			Total Lead (Pb)	2018/09/10	2.2		%	35
			Total Mercury (Hg)	2018/09/10	4.9		%	35
			Total Molybdenum (Mo)	2018/09/10	3.1		%	35
			Total Nickel (Ni)	2018/09/10	0.076		%	30
			Total Selenium (Se)	2018/09/10	13		%	30
			Total Silver (Ag)	2018/09/10	NC		%	35
			Total Thallium (Tl)	2018/09/10	5.2		%	30
			Total Tin (Sn)	2018/09/10	NC		%	35
			Total Uranium (U)	2018/09/10	3.3		%	30
			Total Vanadium (V)	2018/09/10	3.7		%	30
			Total Zinc (Zn)	2018/09/10	0.86		%	30
9135642	BL7	QC Standard	% sand by hydrometer	2018/09/10		95	%	81 - 119
			% silt by hydrometer	2018/09/10		106	%	85 - 115
			Clay Content	2018/09/10		103	%	82 - 118
9135642	BL7	RPD	% sand by hydrometer	2018/09/10	1.3		%	30
			% silt by hydrometer	2018/09/10	2.0		%	30
			Clay Content	2018/09/10	0.0084		%	30
9135665	MAP	Matrix Spike	Soluble (Hot water) Boron (B)	2018/09/10		98	%	75 - 125
9135665	MAP	Spiked Blank	Soluble (Hot water) Boron (B)	2018/09/10		96	%	80 - 120
9135665	MAP	Method Blank	Soluble (Hot water) Boron (B)	2018/09/10	<0.10		mg/kg	
9135665	MAP	RPD	Soluble (Hot water) Boron (B)	2018/09/10	5.7		%	35
9136039	ZI	Matrix Spike	Hex. Chromium (Cr 6+)	2018/09/10		103	%	75 - 125
9136039	ZI	Spiked Blank	Hex. Chromium (Cr 6+)	2018/09/10		102	%	80 - 120
9136039	ZI	Method Blank	Hex. Chromium (Cr 6+)	2018/09/10	<0.080		mg/kg	
9136039	ZI	RPD	Hex. Chromium (Cr 6+)	2018/09/10	NC		%	35
9136349	MAP	Matrix Spike	Soluble Boron (B)	2018/09/10		95	%	75 - 125
9136349	MAP	Spiked Blank	Soluble Boron (B)	2018/09/10		96	%	80 - 120
9136349	MAP	Method Blank	Soluble Boron (B)	2018/09/10	<0.10		mg/L	
9147257	PL	QC Standard	Total Organic Carbon (C)	2018/09/18		102	%	75 - 125
9147257	PL	Spiked Blank	Total Organic Carbon (C)	2018/09/18		98	%	75 - 125
9147257	PL	Method Blank	Total Organic Carbon (C)	2018/09/18	<0.050		%	
9147257	PL	RPD [UG4397-01]	Total Organic Carbon (C)	2018/09/18	12		%	35
9176169	JLP	Matrix Spike	Total Antimony (Sb)	2018/10/09		97	%	75 - 125

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Arsenic (As)	2018/10/09		102	%	75 - 125
			Total Barium (Ba)	2018/10/09		NC	%	75 - 125
			Total Beryllium (Be)	2018/10/09		100	%	75 - 125
			Total Cadmium (Cd)	2018/10/09		97	%	75 - 125
			Total Chromium (Cr)	2018/10/09		99	%	75 - 125
			Total Cobalt (Co)	2018/10/09		96	%	75 - 125
			Total Copper (Cu)	2018/10/09		90	%	75 - 125
			Total Lead (Pb)	2018/10/09		NC	%	75 - 125
			Total Lithium (Li)	2018/10/09		97	%	75 - 125
			Total Manganese (Mn)	2018/10/09		NC	%	75 - 125
			Total Mercury (Hg)	2018/10/09		99	%	75 - 125
			Total Molybdenum (Mo)	2018/10/09		103	%	75 - 125
			Total Nickel (Ni)	2018/10/09		92	%	75 - 125
			Total Selenium (Se)	2018/10/09		100	%	75 - 125
			Total Silver (Ag)	2018/10/09		95	%	75 - 125
			Total Strontium (Sr)	2018/10/09		NC	%	75 - 125
			Total Thallium (Tl)	2018/10/09		94	%	75 - 125
			Total Tin (Sn)	2018/10/09		122	%	75 - 125
			Total Titanium (Ti)	2018/10/09		NC	%	75 - 125
			Total Uranium (U)	2018/10/09		100	%	75 - 125
			Total Vanadium (V)	2018/10/09		94	%	75 - 125
			Total Zinc (Zn)	2018/10/09		NC	%	75 - 125
9176169	JLP	QC Standard	Total Aluminum (Al)	2018/10/09		103	%	70 - 130
			Total Antimony (Sb)	2018/10/09		114	%	70 - 130
			Total Arsenic (As)	2018/10/09		101	%	70 - 130
			Total Barium (Ba)	2018/10/09		111	%	70 - 130
			Total Beryllium (Be)	2018/10/09		104	%	70 - 130
			Total Cadmium (Cd)	2018/10/09		105	%	70 - 130
			Total Calcium (Ca)	2018/10/09		101	%	70 - 130
			Total Chromium (Cr)	2018/10/09		110	%	70 - 130
			Total Cobalt (Co)	2018/10/09		99	%	70 - 130
			Total Copper (Cu)	2018/10/09		102	%	70 - 130
			Total Iron (Fe)	2018/10/09		103	%	70 - 130
			Total Lead (Pb)	2018/10/09		117	%	70 - 130
			Total Lithium (Li)	2018/10/09		100	%	70 - 130
			Total Magnesium (Mg)	2018/10/09		107	%	70 130
			Total Manganese (Mn)	2018/10/09		110	%	70 - 130
			Total Mercury (Hg)	2018/10/09		100	%	70 - 130
			Total Molybdenum (Mo)	2018/10/09		110	%	70 - 130
			Total Nickel (Ni)	2018/10/09		106	%	70 - 130
			Total Phosphorus (P)	2018/10/09		103	%	70 - 130
			Total Potassium (K)	2018/10/09		100	%	70 - 130
			Total Silver (Ag)	2018/10/09		122	%	70 - 130
			Total Sodium (Na)	2018/10/09		100	%	70 - 130
			Total Strontium (Sr)	2018/10/09		114	%	70 - 130
			Total Thallium (Tl)	2018/10/09		94	%	70 - 130
			Total Tin (Sn)	2018/10/09		98	%	70 - 130
			Total Uranium (U)	2018/10/09		98	%	70 - 130
			Total Vanadium (V)	2018/10/09		108	%	70 - 130
			Total Zinc (Zn)	2018/10/09		103	%	70 - 130
9176169	JLP	Spiked Blank	Total Antimony (Sb)	2018/10/09		100	%	75 - 125
			Total Arsenic (As)	2018/10/09		98	%	75 - 125
			Total Barium (Ba)	2018/10/09		96	%	75 - 125
			Total Beryllium (Be)	2018/10/09		94	%	75 - 125
			Total Cadmium (Cd)	2018/10/09		93	%	75 - 125

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Report Date: 2018/10/15

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Chromium (Cr)	2018/10/09		94	%	75 - 125
			Total Cobalt (Co)	2018/10/09		92	%	75 - 125
			Total Copper (Cu)	2018/10/09		89	%	75 - 125
			Total Lead (Pb)	2018/10/09		94	%	75 - 125
			Total Lithium (Li)	2018/10/09		94	%	75 - 125
			Total Manganese (Mn)	2018/10/09		90	%	75 - 125
			Total Mercury (Hg)	2018/10/09		94	%	75 - 125
			Total Molybdenum (Mo)	2018/10/09		97	%	75 - 125
			Total Nickel (Ni)	2018/10/09		92	%	75 - 125
			Total Selenium (Se)	2018/10/09		95	%	75 - 125
			Total Silver (Ag)	2018/10/09		93	%	75 - 125
			Total Strontium (Sr)	2018/10/09		94	%	75 - 125
			Total Thallium (Tl)	2018/10/09		92	%	75 - 125
			Total Tin (Sn)	2018/10/09		97	%	75 - 125
			Total Titanium (Ti)	2018/10/09		92	%	75 - 125
			Total Uranium (U)	2018/10/09		91	%	75 - 125
			Total Vanadium (V)	2018/10/09		93	%	75 - 125
			Total Zinc (Zn)	2018/10/09		91	%	75 - 125
9176169	JLP	Method Blank	Total Aluminum (Al)	2018/10/09	<100		mg/kg	
			Total Antimony (Sb)	2018/10/09	<0.10		mg/kg	
			Total Arsenic (As)	2018/10/09	<0.50		mg/kg	
			Total Barium (Ba)	2018/10/09	<0.10		mg/kg	
			Total Beryllium (Be)	2018/10/09	<0.20		mg/kg	
			Total Bismuth (Bi)	2018/10/09	<0.10		mg/kg	
			Total Boron (B)	2018/10/09	<1.0		mg/kg	
			Total Cadmium (Cd)	2018/10/09	<0.050		mg/kg	
			Total Calcium (Ca)	2018/10/09	<100		mg/kg	
			Total Chromium (Cr)	2018/10/09	<1.0		mg/kg	
			Total Cobalt (Co)	2018/10/09	<0.30		mg/kg	
			Total Copper (Cu)	2018/10/09	<0.50		mg/kg	
			Total Iron (Fe)	2018/10/09	<100		mg/kg	
			Total Lead (Pb)	2018/10/09	<0.10		mg/kg	
			Total Lithium (Li)	2018/10/09	<5.0		mg/kg	
			Total Magnesium (Mg)	2018/10/09	<100		mg/kg	
			Total Manganese (Mn)	2018/10/09	<0.20		mg/kg	
			Total Mercury (Hg)	2018/10/09	<0.050		mg/kg	
			Total Molybdenum (Mo)	2018/10/09	<0.10		mg/kg	
			Total Nickel (Ni)	2018/10/09	<0.80		mg/kg	
			Total Phosphorus (P)	2018/10/09	<10		mg/kg	
			Total Potassium (K)	2018/10/09	<100		mg/kg	
			Total Selenium (Se)	2018/10/09	<0.50		mg/kg	
			Total Silver (Ag)	2018/10/09	<0.050		mg/kg	
			Total Sodium (Na)	2018/10/09	<100		mg/kg	
			Total Strontium (Sr)	2018/10/09	<0.10		mg/kg	
			Total Thallium (Tl)	2018/10/09	<0.050		mg/kg	
			Total Tin (Sn)	2018/10/09	<0.10		mg/kg	
			Total Titanium (Ti)	2018/10/09	<1.0		mg/kg	
			Total Tungsten (W)	2018/10/09	<0.50		mg/kg	
			Total Uranium (U)	2018/10/09	<0.050		mg/kg	
			Total Vanadium (V)	2018/10/09	<2.0		mg/kg	
			Total Zinc (Zn)	2018/10/09	<1.0		mg/kg	
			Total Zirconium (Zr)	2018/10/09	<0.50		mg/kg	
9176169	JLP	RPD	Total Aluminum (Al)	2018/10/09	4.1		%	40
			Total Antimony (Sb)	2018/10/09	18		%	30
			Total Arsenic (As)	2018/10/09	9.3		%	30

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Barium (Ba)	2018/10/09	8.3		%	40
			Total Beryllium (Be)	2018/10/09	13		%	30
			Total Boron (B)	2018/10/09	64 (1)		%	30
			Total Cadmium (Cd)	2018/10/09	3.9		%	30
			Total Chromium (Cr)	2018/10/09	7.7		%	30
			Total Cobalt (Co)	2018/10/09	6.5		%	30
			Total Copper (Cu)	2018/10/09	19		%	30
			Total Iron (Fe)	2018/10/09	9.5		%	30
			Total Lead (Pb)	2018/10/09	21		%	40
			Total Lithium (Li)	2018/10/09	8.5		%	30
			Total Manganese (Mn)	2018/10/09	11		%	30
			Total Mercury (Hg)	2018/10/09	30		%	40
			Total Molybdenum (Mo)	2018/10/09	17		%	40
			Total Nickel (Ni)	2018/10/09	9.0		%	30
			Total Selenium (Se)	2018/10/09	NC		%	30
			Total Silver (Ag)	2018/10/09	30		%	40
			Total Strontium (Sr)	2018/10/09	11		%	40
			Total Thallium (Tl)	2018/10/09	24		%	30
			Total Tin (Sn)	2018/10/09	45 (1)		%	40
			Total Titanium (Ti)	2018/10/09	14		%	40
			Total Tungsten (W)	2018/10/09	NC		%	30
			Total Uranium (U)	2018/10/09	11		%	30
			Total Vanadium (V)	2018/10/09	9.6		%	30
			Total Zinc (Zn)	2018/10/09	0.30		%	30
9176170	VCN	Spiked Blank	Soluble (2:1) pH	2018/10/09		100	%	97 - 103
9176170	VCN	RPD	Soluble (2:1) pH	2018/10/09	0.14		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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Client Project #: CNRL9078

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

s.19(1)

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Chain of Custody

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Address:
Ph: 604-926-3261 Cell:

Report Distribution (E-Mail): [redacted]

REGULATORY GUIDELINES:
O AT1
O CCME
O Regulated Drinking Water
O Other

All samples are held for 60 calendar days after sample receipt, unless specified otherwise

PO #:
Project #: CNRL9078
Project Name:
Site Location:
Quote #: B80281
Sampled By:

Received in Fort McMurray
By: [illegible]
SEP 06 2018 @ 1:55 pm
Temp: 2 / 1 / 1

SERVICE REQUESTED:
X RUSH (Contact lab to reserve) Date Required:
O REGULAR (5 to 7 Days)

#	Sample ID	Matrix (GW, SW, Sediment)	Date/Time Sampled YY/MM/DD 24:00	BOD	DOC and low loeve Diss Phosphorus	TOC and low level Total Phosphorus	Nitrogen (total), Calc. TKN, NO3, NO2	Amonia-N (total) and TKN	True Colour	Chl-a	Phenols (4-AAP)	TSS and TDS	Sulphide	Routine Water and Diss regulated metals	Regulated metals (CCME?AT1) - Total	Naphthenic Acids by IR	Hydrocarbon by IR (Mineral oil & grease) - TPHIR	Methyl-mercury (sub)	Untra low level Mercury total and diss. (sub)	BTEX/F1	Organics (F2-F4/Moisture)	Inorganics (Metals/pH/texture/TOC)	Organics (Moisture)	Texture/TOC	HOLD - Do not Analyze	# of Containers Submitted
1	BEN-1	Sediment	Sept.4 - 1505																	x	x	x				7
2	BEN-2	Sediment	Sept 5. -1857																	x	x	x				7
3	BEN-3	Sediment	Sept5-1510																	x	x	x				7
4	BEN-4	Sediment	Sept4 - 1555																				x	x		5
5	BEN-5	Sediment	Sept5 - 1310																				x	x		5
6	BEN-6	Sediment	Sept 5-1550																				x	x		5
7	BEN-7	Sediment	Sept 5-1140																				x	x		5
8	BEN-8	Sediment	Sept 5-1225																				x	x		5
9	BEN-9	Sediment	Sept5-1630																				x	x		5
10	SSP-1	Sediment	Sept.5 -1020																	x	x	x				7
11																										
12																										

Please Indicate Filtered, Preserved or Both (F, P, F/P)

Relinquished By (Signature/Print): [redacted] / Aurora Jansen Date (YY/MM/DD): 06sept2018 Time (24:00): 13:55
Relinquished By (Signature/Print): [redacted] Date (YY/MM/DD): Time (24:00):
Special Instructions: # of Jars Used & Not Submitted

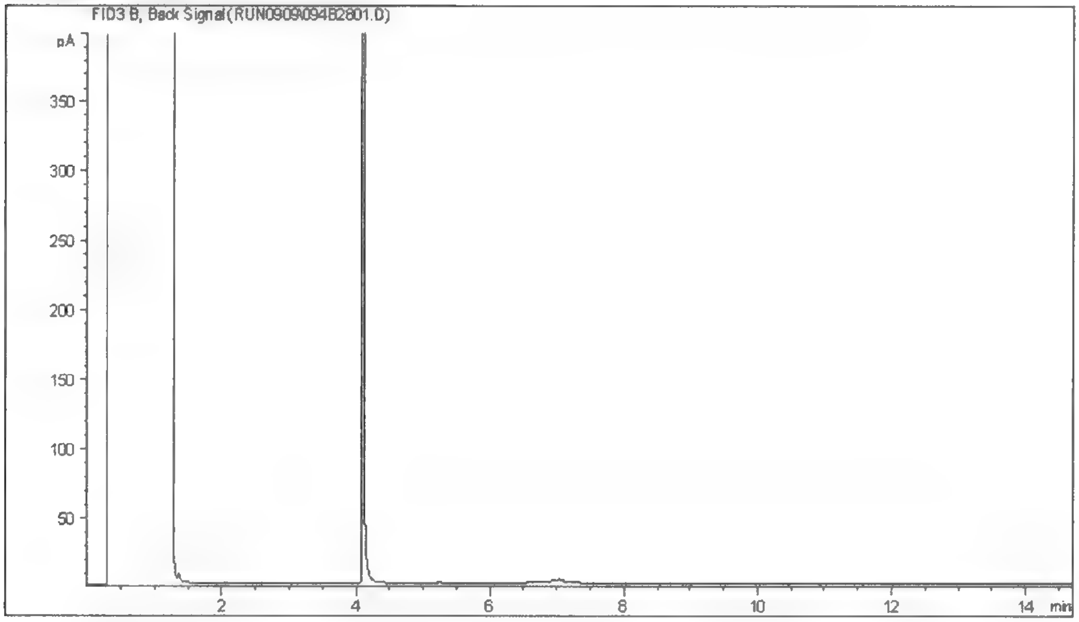
LAB USE ONLY
Received By: [redacted] Date: 2018/09/06 Time: 07:00
Maxxam Job #
Lab Comments
Custody Seal | Temperature | Ice
Refer to ACT12

13-Sep-18 13:55
Geraldlyn Gouthro
B876673
IL4 INS-0003

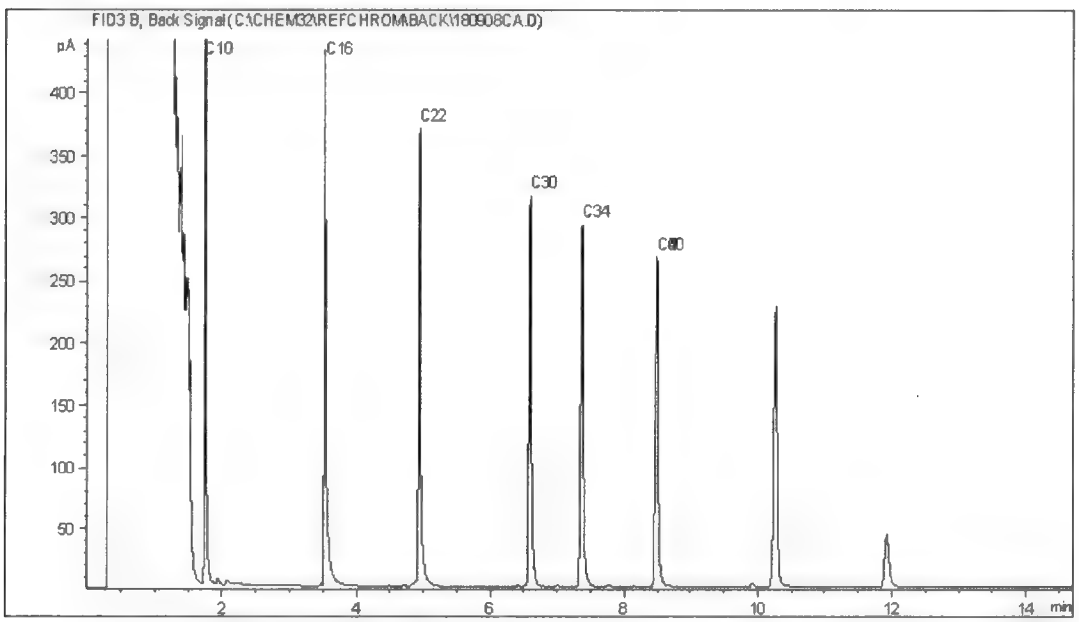
001788

CCME Hydrocarbons (F2-F4 in soil) Chromatogram

Instrument: GC13



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

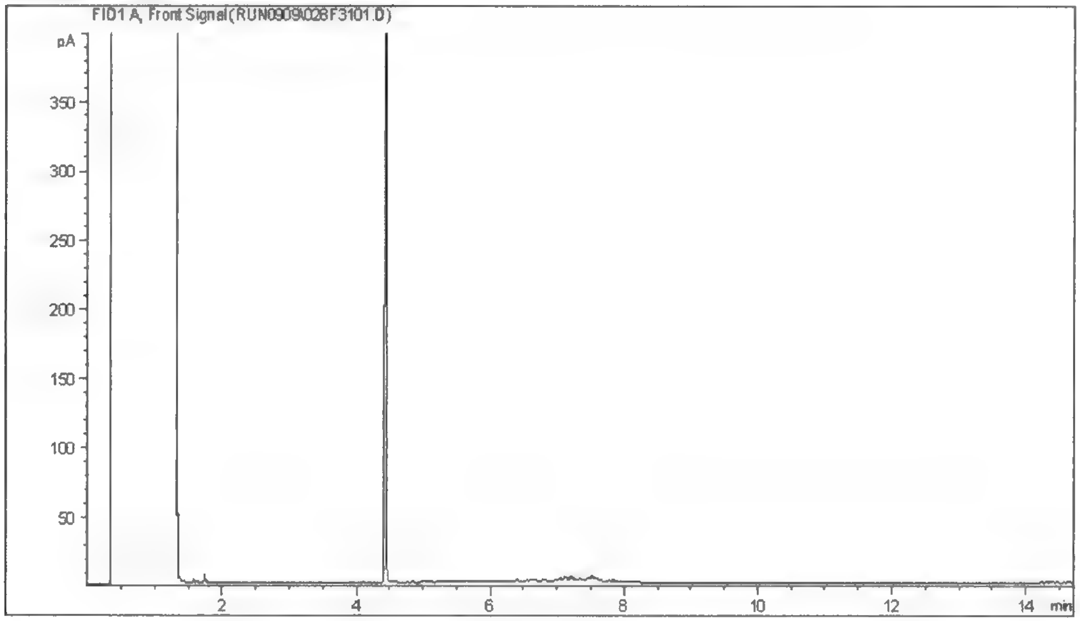
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B876673
Report Date: 2018/10/15
Maxxam Sample: UG4389

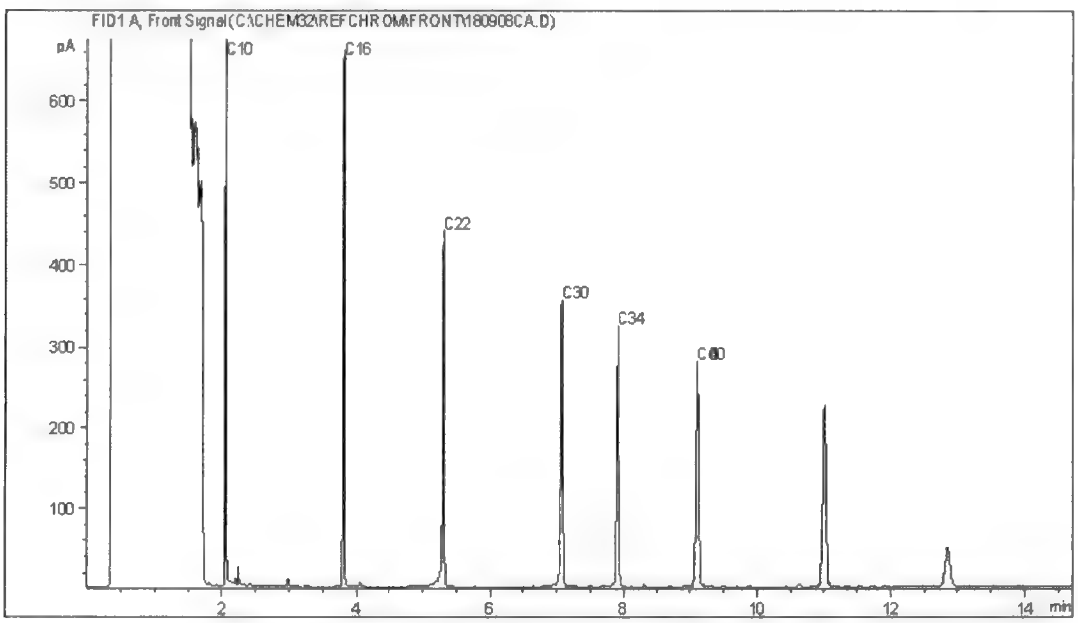
HATFIELD CONSULTANTS
Client Project #: CNRL9078
Client ID: BEN-2

CCME Hydrocarbons (F2-F4 in soil) Chromatogram

Instrument: GC13



Carbon Range Distribution - Reference Chromatogram



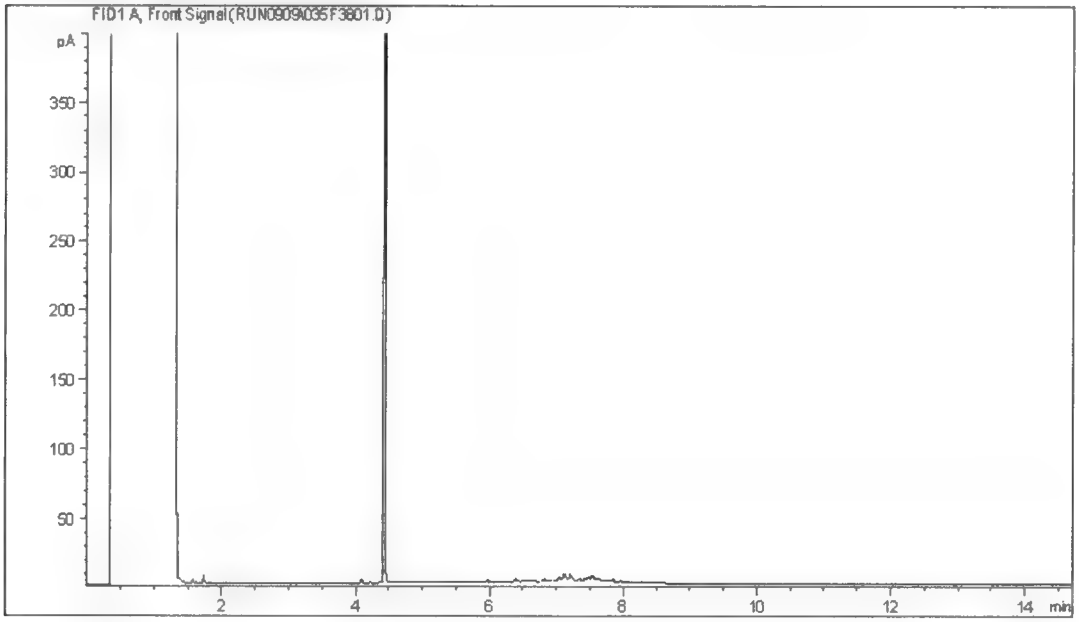
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

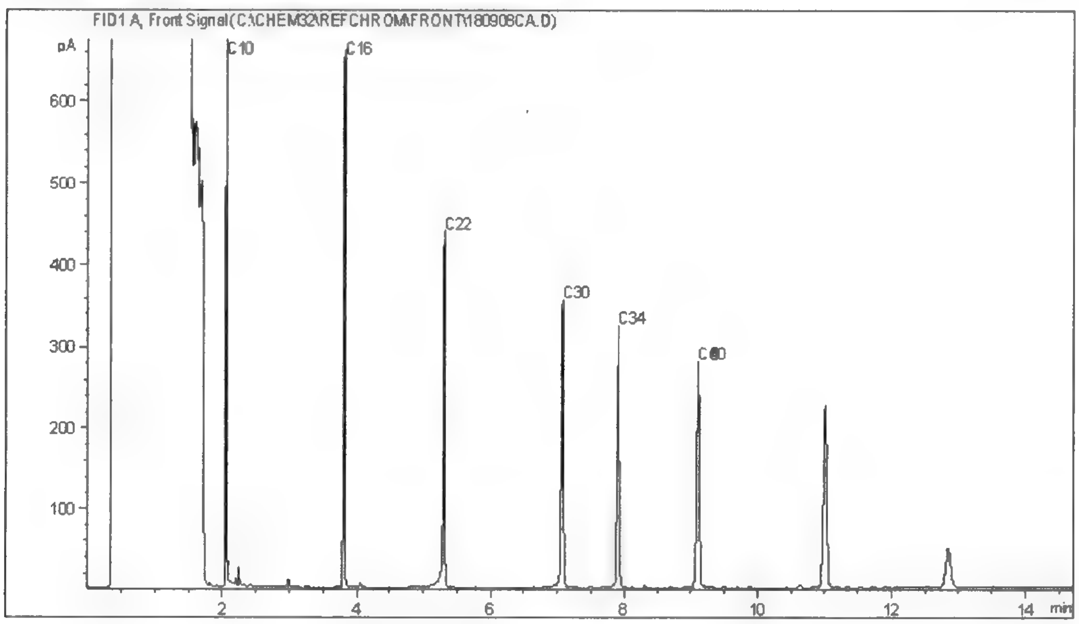
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons (F2-F4 in soil) Chromatogram

Instrument: GC13



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

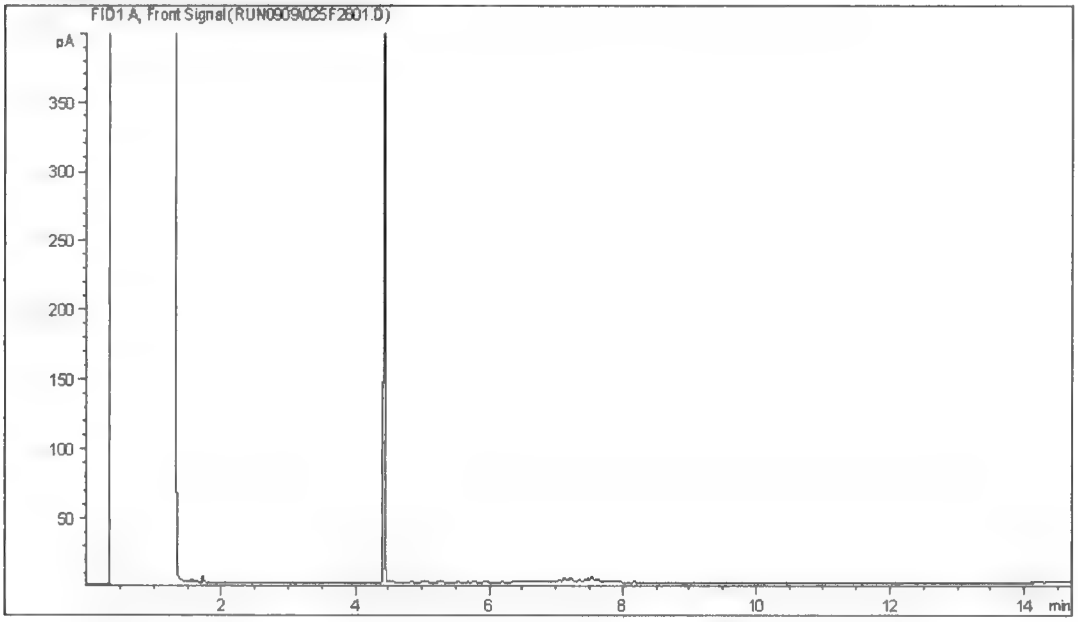
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B876673
Report Date: 2018/10/15
Maxxam Sample: UG4397

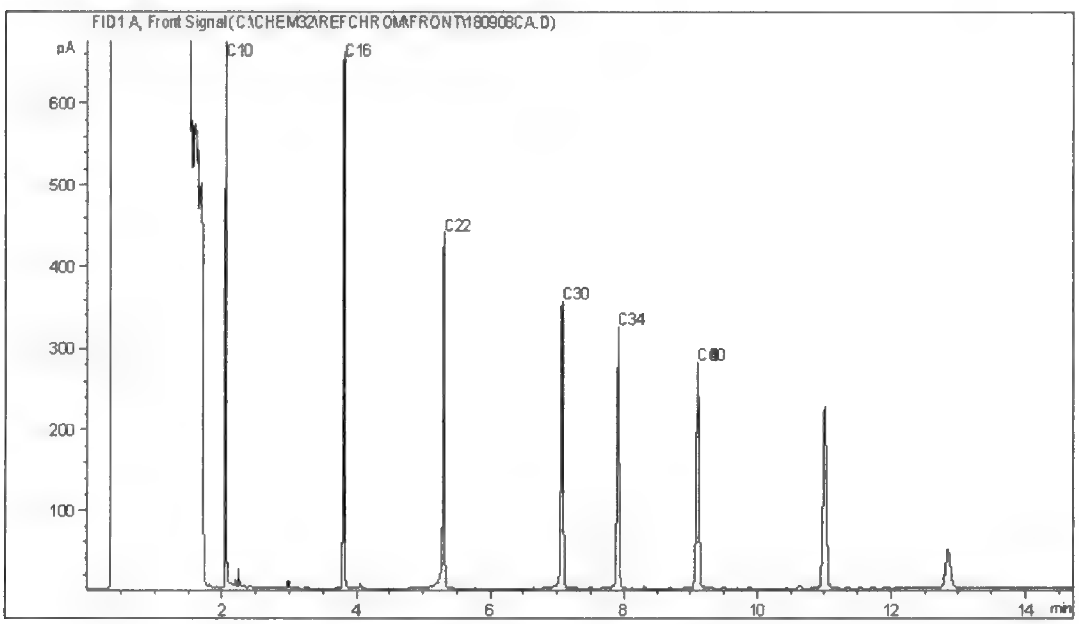
HATFIELD CONSULTANTS
Client Project #: CNRL9078
Client ID: SSP-1

CCME Hydrocarbons (F2-F4 in soil) Chromatogram

Instrument: GC13



Carbon Range Distribution - Reference Chromatogram



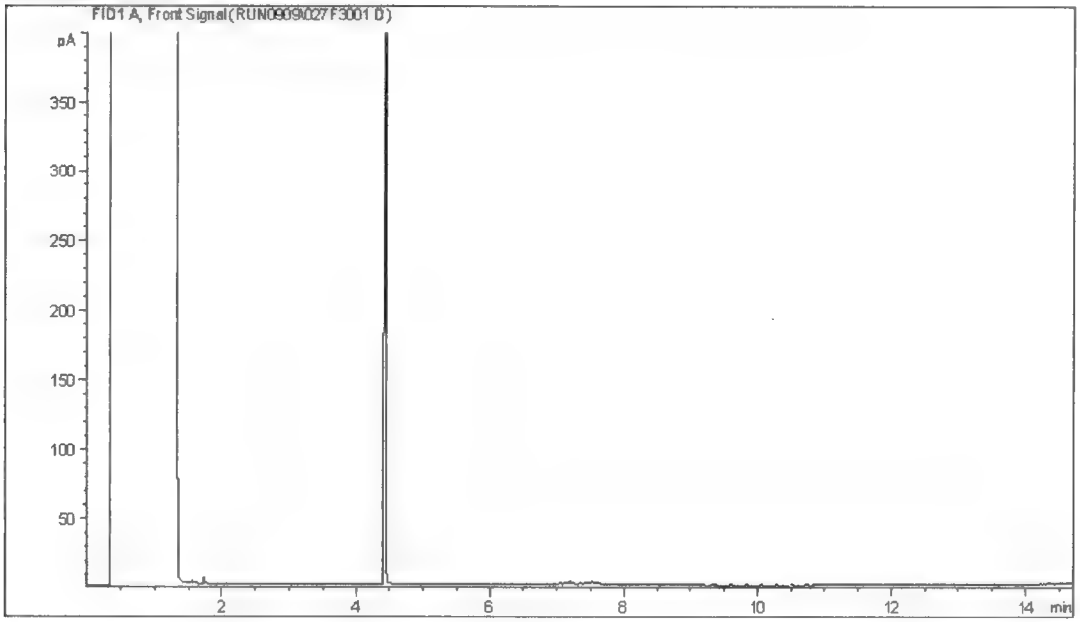
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

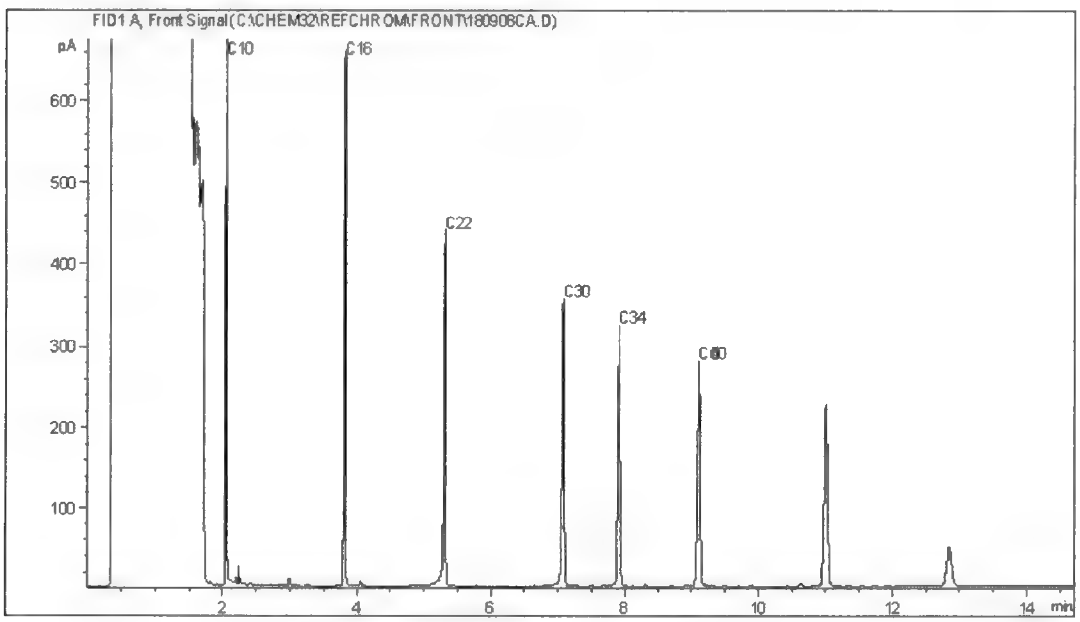
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons (F2-F4 in soil) Chromatogram

Instrument: GC13



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

SGS AXYS
2045 Mills Road West
Sidney, BC, Canada V8L5X2
TEL: (250) 655-5800
TOLL-FREE: 1-888-373-0881

SGS AXYS Client No.: 2600

Client Address: Hatfield Consultants
200-850 Harbourside Drive
North Vancouver, BC, Canada, V7P 0A3

The SGS AXYS contact for these data is Georgina Brooks.

BATCH SUMMARY

Batch ID:	WG65361	***Date:*** 09-Oct-2018
Analysis Type:	PAH	***Matrix Type:*** Solid

BATCH MAKEUP

Contract: 2600

Samples:

L30046-1	BEN-1
L30046-2	BEN-2
L30046-3	BEN-3
L30046-4	SSP-1

Blank: WG65361-101

Reference or Spike: WG65361-102

Duplicate:

Comments:

1. Data are considered final.
2. Data are not blank corrected. Blank data should be taken into consideration when evaluating sample data.
3. Blank data should be evaluated against specifications using the same blank sample size as the size of the client samples.

FQA-006 Rev. 4. 20-Sep-2013

www.axysanalytical.com

s.19(1)

CHAIN OF CUSTODY

2045 Mills Road West TEL: (250) 655-5800 TOLL FREE 1-888-373-0881
Sidney, British Columbia, Canada V8L 5X2 FAX: (250) 655-5811

SGS AXYS CLIENT #: 2600

REPORT TO:

Company: HATFIELD CONSULTANTS
Address: SUITE A, 300 MACKENZIE BLVD
FORT McMURRAY, AB
T9H 4C4
Contact: MEGHAN ISAACS, DAN MOATS
Phone: 604-926-3261
FAX: –
E-mail: [redacted]

INVOICE TO:

Company:
Address:
Contact: IMSOOK CHA, MEGHAN ISAACS
Phone:
FAX:
E-mail: [redacted]

Project Name Num: CNRL9078

Sampler's Name: AURORA JANSEN
Signature: [redacted]

Client Sample Identification	Matrix	Sampling Date	Sampling Time	Container Type No	SGS AXYS Lab Sample ID (Lab use only)	O-6858 (PAHs)				
BEN-1	SEDIMENT	04-SEP-18	15:05	250mL GLASS	L30046-1	X				
BEN-2	↓	05-SEP-18	09:57	↓	-2	X				
BEN-3		05-SEP-18	15:10		-3	X				
SSP-1		05-SEP-18	10:20		-4	X				

ANALYSIS REQUESTED

Relinquished by (Signature)	Date	Time	Received by (Signature)	Date	Time
[redacted]	07-SEP-18	09:00	[signature]	12-SEP-2018	11:00
Relinquished by (Signature)	Date	Time	Received by (Signature)	Date	Time

Remarks

Courier	Waybill No

Sample Receipt

	Cooler
Temp °C	
Custody Seal #	
Seal Intact Y N	
Sample Tags Y N	

SGS AXYS METHOD MLA-021 Rev 12

CLIENT SAMPLE NO.
BEN-1
Sample Collection:
04-Sep-2018 15:05

Form 1A
POLYAROMATIC HYDROCARBON ANALYSIS REPORT

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	CNRL9078 HORIZON LAKE
Contract No.:	2600	**Lab Sample I.D.:**	L30046-1 L
Matrix:	SOLID	**Sample Size:**	10.7 g (dry)
Sample Receipt Date:	12-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	03-Oct-2018 **Time:** 16:08:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4827.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4816.D
Concentration Units:	ng/g (dry weight basis)	**% Moisture:**	44.3

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
Naphthalene	91-20-3	NDR	0.968	0.181 (S)	0.09	1.007
Acenaphthylene	208-96-8	ND		0.044 (S)		
Acenaphthene	83-32-9		1.92	0.093 (S)	1.20	1.048
2-Methylfluorene	1430-97-3		0.481	0.197 (S)	1.21	0.939
C2 Phenanthrenes/Anthracenes			24.2	0.114 (S)		
Fluorene	86-73-7		1.69	0.050 (S)	1.07	0.844
Phenanthrene	85-01-8		4.47	0.113 (S)	0.21	1.004
Anthracene	120-12-7	NDR	0.267	0.112 (S)	0.26	1.011
C1 Phenanthrenes/Anthracenes			15.6	0.229 (S)		
Fluoranthene	206-44-0		3.62	0.137 (S)	0.19	1.002
Pyrene	129-00-0		5.75	0.134 (S)	0.21	1.033
Benz[a]anthracene [3]	56-55-3		1.70	0.200 (S)	0.31	1.003
Chrysene [4]	218-01-9		10.2	0.211 (S)	0.33	1.002
Benzo[b]fluoranthene	205-99-2		10.9	0.107 (S)	0.22	1.004
Benzo[j,k]fluoranthenes			3.73	0.120 (S)	0.24	1.002
Benzo[e]pyrene	192-97-2		9.86	0.143 (S)	0.25	0.996
Benzo[a]pyrene	50-32-8		4.87	0.156 (S)	0.19	1.004
Perylene	198-55-0		170	0.162 (S)	0.22	1.004
Dibenz[a,h]anthracene [5]	53-70-3	NDR	1.95	0.420 (S)	0.55	1.003
Indeno[1,2,3-cd]pyrene	193-39-5		6.58	0.367 (S)	0.19	1.002
Benzo[ghi]perylene	191-24-2		12.2	0.331 (S)	0.23	1.003
2-Methylnaphthalene	91-57-6		1.33	0.113 (S)	0.90	1.009
1-Methylnaphthalene	90-12-0		1.86	0.119 (S)	0.91	1.040
C1-Naphthalenes			3.20	0.113 (S)		
Biphenyl	92-52-4		0.467	0.069 (S)	0.33	1.006
C1-Biphenyls			0.698	0.054 (S)		
C2-Biphenyls			1.44	0.058 (S)		
C2-Naphthalenes			12.9	0.320 (S)		
1,2-Dimethylnaphthalene	573-98-8	NDR	0.372	0.320 (S)	4.82	1.082

s.19(1)

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
2,6-Dimethylnaphthalene	581-42-0		1.57	0.261 (S)	0.71	1.011
C3-Naphthalenes			23.2	0.152 (S)		
2,3,6-Trimethylnaphthalene	829-26-5		5.92	0.147 (S)	0.96	1.208
2,3,5-Trimethylnaphthalene	2245-38-7		5.20	0.156 (S)	0.94	1.229
C4-Naphthalenes			19.9	0.139 (S)		
C1-Acenaphthenes			0.270	0.072 (S)		
C1-Fluorenes			4.12	0.197 (S)		
1,7-Dimethylfluorene	442-66-0		0.925	0.208 (S)	0.07	1.034
C2-Fluorenes			12.8	0.208 (S)		
C3-Fluorenes			21.4	0.301 (S)		
Dibenzothiophene	132-65-0	NDR	1.23	0.102 (S)	0.37	1.003
C1-Dibenzothiophenes			6.19	0.355 (S)		
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3		1.94	0.355 (S)	0.74	1.095
C2-Dibenzothiophenes			20.2	0.136 (S)		
2,4-Dimethyldibenzothiophene	31317-18-7	NDR	1.86	0.136 (S)	1.10	1.163
C3-Dibenzothiophenes			27.2	0.245 (S)		
C4-Dibenzothiophenes			21.4	0.133 (S)		
3-Methylphenanthrene	832-71-3		2.56	0.231 (S)	0.60	1.088
2-Methylphenanthrene	2531-84-2		2.81	0.227 (S)	0.62	1.092
2-Methylanthracene	613-12-7	NDR	0.315	0.236 (S)	0.72	1.098
9/4-Methylphenanthrene	883-20-5/832-64-4		6.60	0.231 (S)	0.63	1.107
1-Methylphenanthrene	832-69-9		3.65	0.229 (S)	0.65	1.110
3,6-Dimethylphenanthrene	1576-67-6	NDR	1.72	0.115 (S)	1.12	0.969
2,6-Dimethylphenanthrene	17980-16-4		1.40	0.114 (S)	0.33	0.975
1,7-Dimethylphenanthrene	483-87-4		2.57	0.114 (S)	0.37	0.993
1,8-Dimethylphenanthrene	7372-87-4		0.828	0.114 (S)	0.35	1.007
C3-Phenanthrenes/Anthracenes			22.9	0.552 (S)		
1,2,6-Trimethylphenanthrene	30436-55-6	NDR	0.971	0.552 (S)	0.78	1.076
Retene	483-65-8		32.9	0.767 (S)	1.57	1.083
C4-Phenanthrenes/Anthracenes			99.3	0.767 (S)		
C1-Fluoranthenes/Pyrenes			26.7	0.384 (S)		
3-Methylfluoranthene/Benzo[a]fluorene	1706-01-0/238-84-6		8.54	0.384 (S)	1.06	1.083
C2-Fluoranthenes/Pyrenes			33.0	0.140 (S)		
C3-Fluoranthenes/Pyrenes			25.4	0.263 (S)		
C4-Fluoranthenes/Pyrenes			14.5	0.275 (S)		
C1-Benzo[a]anthracenes/Chrysenes [4]			27.0	0.199 (S)		
5/6-Methylchrysene	3697-24-3/1705-85-7		2.21	0.201 (S)		1.065
1-Methylchrysene	3351-28-8		6.07	0.197 (S)		1.072
C2-Benzo[a]anthracenes/Chrysenes [4]			28.8	0.508 (S)		
5,9-Dimethylchrysene	139493-40-6		7.48	0.508 (S)		1.125
C3-Benzo[a]anthracenes/Chrysenes [4]			6.60	0.319 (S)		
C4-Benzo[a]anthracenes/Chrysenes [4]			3.69	0.305 (S)		
C1-Benzofluoranthenes/Benzopyrenes			54.7	0.257 (S)		
7-Methylbenzo[a]pyrene	63041-77-0		2.14	0.257 (S)		1.108
C2-Benzofluoranthenes/Benzopyrenes			15.2	0.516 (S)		
1,4,6,7-Tetramethylnaphthalene	13764-18-6	NDR	2.63	0.139 (S)	0.09	1.380

(1) Where applicable, custom lab flags have been used on this report; ND = not detected at RL; NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = minimum reporting level.
(3) May co-elute with Cyclopenta(cd)pyrene.
(4) May co-elute with Triphenylene.
(5) May co-elute with Dibenz[a,c]anthracene.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________[redacted]__________

For Axys Internal Use Only [XSL Template: Pest1A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: PAH_PAH_LO_LPAHF_L30046-1_Form1A_PH8S4827.D_SJ2442009.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

Form 2

POLYAROMATIC HYDROCARBON ANALYSIS REPORT

CLIENT SAMPLE NO.
BEN-1
Sample Collection:
04-Sep-2018 15:05

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Project No.			CNRL9078 HORIZON LAKE
Contract No.:	2600	**Lab Sample I.D.:**	L30046-1 L
Matrix:	SOLID	**Sample Size:**	10.7 g (dry)
Sample Receipt Date:	12-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	03-Oct-2018 **Time:** 16:08:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4827.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4816.D
Concentration Units:	ng absolute	**% Moisture:**	44.3

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO	RRT
Naphthalene d-8		2000	504	25.2	0.09	0.606
2-Methylnaphthalene d-10		1970	666	33.8	0.19	0.754
Biphenyl d-10		2050	1080	53.0		0.867
2,6-Dimethylnaphthalene d-12		2060	891	43.4	0.75	0.895
Acenaphthylene d-8		2060	1300	63.1	0.15	0.961
Dibenzothiophene d-8		2040	1430	70.1	0.09	0.792
Phenanthrene d-10		1810	1460	80.8	0.15	0.808
Fluoranthene d-10		1990	1770	89.2	0.16	0.971
Benzo[a]anthracene d-12		2030	1940	95.5	0.24	1.164
Chrysene d-12		1960	1840	94.1	0.26	1.169
Benzo[b]fluoranthene d-12		1970	1750	88.6	0.21	0.958
Benzo[k]fluoranthene d-12		2000	1780	89.1	0.20	0.962
Benzo[a]pyrene d-12		2070	1840	89.1	0.20	1.008
Perylene d-12		2150	1950	90.8	0.24	1.024
Dibenzo[a,h]anthracene d-14		1920	1940	101	0.24	1.211
Indeno[1,2,3-cd]pyrene d-12		1990	1890	94.9	0.18	1.207
Benzo[ghi]perylene d-12		1980	1850	93.4	0.19	1.238

(1) Where applicable, custom lab flags have been used on this report.
(2) R% = percent recovery.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ____________[redacted]__________

For Axys Internal Use Only [XSL Template: Pest2.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50; Report Filename: PAH_PAH_LO_LPAHF_L30046-1_Form2_PH8S4827.D_SJ2442009.html; Workgroup: WG65361; Design ID: 526]

SGS AXYS METHOD MLA-021 Rev 12

Form 1A

POLYAROMATIC HYDROCARBON ANALYSIS REPORT

CLIENT SAMPLE NO.
BEN-2
Sample Collection:
05-Sep-2018 09:57

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	CNRL9078 HORIZON LAKE
Contract No.:	2600	**Lab Sample I.D.:**	L30046-2
Matrix:	SOLID	**Sample Size:**	10.3 g (dry)
Sample Receipt Date:	12-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	02-Oct-2018 **Time:** 04:25:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4781.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4771.D
Concentration Units:	ng/g (dry weight basis)	**% Moisture:**	41.9

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
Naphthalene	91-20-3		0.963	0.100 (S)	0.08	1.006
Acenaphthylene	208-96-8	NDR	0.045	0.043 (S)	0.95	1.003
Acenaphthene	83-32-9		1.19	0.088 (S)	1.22	1.048
2-Methylfluorene	1430-97-3		0.435	0.087 (S)	1.44	0.939
C2 Phenanthrenes/Anthracenes			20.5	0.043 (S)		
Fluorene	86-73-7		1.45	0.069 (S)	1.01	0.844
Phenanthrene	85-01-8		3.57	0.069 (S)	0.19	1.004
Anthracene	120-12-7	NDR	0.238	0.068 (S)	0.32	1.012
C1 Phenanthrenes/Anthracenes			12.7	0.207 (S)		
Fluoranthene	206-44-0		2.52	0.103 (S)	0.21	1.002
Pyrene	129-00-0		4.63	0.101 (S)	0.21	1.033
Benz[a]anthracene [3]	56-55-3		1.68	0.121 (S)	0.31	1.002
Chrysene [4]	218-01-9		8.69	0.128 (S)	0.34	1.002
Benzo[b]fluoranthene	205-99-2		7.50	0.289 (S)	0.20	1.004
Benzo[j,k]fluoranthenes			2.57	0.317 (S)	0.24	1.002
Benzo[e]pyrene	192-97-2		7.42	0.389 (S)	0.25	0.996
Benzo[a]pyrene	50-32-8		3.90	0.425 (S)	0.17	1.003
Perylene	198-55-0		116	0.420 (S)	0.22	1.004
Dibenz[a,h]anthracene [5]	53-70-3	NDR	1.70	0.145 (S)	0.55	1.003
Indeno[1,2,3-cd]pyrene	193-39-5		4.52	0.295 (S)	0.23	1.002
Benzo[ghi]perylene	191-24-2		9.02	0.278 (S)	0.25	1.002
2-Methylnaphthalene	91-57-6		1.28	0.073 (S)	0.93	1.009
1-Methylnaphthalene	90-12-0		1.39	0.078 (S)	0.90	1.040
C1-Naphthalenes			2.67	0.073 (S)		
Biphenyl	92-52-4		0.375	0.060 (S)	0.33	1.005
C1-Biphenyls			0.705	0.049 (S)		
C2-Biphenyls			1.34	0.033 (S)		
C2-Naphthalenes			10.0	0.145 (S)		
1,2-Dimethylnaphthalene	573-98-8	NDR	0.515	0.145 (S)	2.25	1.082

s.19(1)

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COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
2,6-Dimethylnaphthalene	581-42-0		1.97	0.118 (S)	0.76	1.011
C3-Naphthalenes			15.2	0.182 (S)		
2,3,6-Trimethylnaphthalene	829-26-5		3.86	0.176 (S)	0.92	1.206
2,3,5-Trimethylnaphthalene	2245-38-7		3.22	0.187 (S)	1.00	1.228
C4-Naphthalenes			12.3	0.257 (S)		
C1-Acenaphthenes			0.156	0.058 (S)		
C1-Fluorenes			3.52	0.087 (S)		
1,7-Dimethylfluorene	442-66-0		0.652	0.187 (S)	0.07	1.034
C2-Fluorenes			11.8	0.187 (S)		
C3-Fluorenes			18.2	0.322 (S)		
Dibenzothiophene	132-65-0	NDR	1.13	0.090 (S)	0.27	1.003
C1-Dibenzothiophenes			6.25	0.088 (S)		
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3		1.74	0.088 (S)	0.79	1.094
C2-Dibenzothiophenes			23.1	0.137 (S)		
2,4-Dimethyldibenzothiophene	31317-18-7	NDR	2.12	0.137 (S)	0.84	1.162
C3-Dibenzothiophenes			32.6	0.248 (S)		
C4-Dibenzothiophenes			35.3	0.242 (S)		
3-Methylphenanthrene	832-71-3		2.35	0.209 (S)	0.61	1.088
2-Methylphenanthrene	2531-84-2		2.25	0.205 (S)	0.58	1.092
2-Methylanthracene	613-12-7		0.312	0.214 (S)	0.52	1.098
9/4-Methylphenanthrene	883-20-5/832-64-4		5.04	0.209 (S)	0.61	1.106
1-Methylphenanthrene	832-69-9		2.79	0.207 (S)	0.69	1.110
3,6-Dimethylphenanthrene	1576-67-6	NDR	1.76	0.044 (S)	1.10	0.969
2,6-Dimethylphenanthrene	17980-16-4		1.31	0.043 (S)	0.29	0.975
1,7-Dimethylphenanthrene	483-87-4	NDR	2.51	0.043 (S)	0.55	0.993
1,8-Dimethylphenanthrene	7372-87-4		0.817	0.043 (S)	0.30	1.007
C3-Phenanthrenes/Anthracenes			21.8	0.169 (S)		
1,2,6-Trimethylphenanthrene	30436-55-6	NDR	1.08	0.169 (S)	0.98	1.076
Retene	483-65-8		14.9	0.869 (S)	1.48	1.083
C4-Phenanthrenes/Anthracenes			93.1	0.869 (S)		
C1-Fluoranthenes/Pyrenes			22.4	0.264 (S)		
3-Methylfluoranthene/Benzo[a]fluorene	1706-01-0/238-84-6		7.08	0.264 (S)	1.05	1.083
C2-Fluoranthenes/Pyrenes			31.2	0.187 (S)		
C3-Fluoranthenes/Pyrenes			25.8	0.195 (S)		
C4-Fluoranthenes/Pyrenes			11.0	0.216 (S)		
C1-Benzo[a]anthracenes/Chrysenes [4]			23.4	0.152 (S)		
5/6-Methylchrysene	3697-24-3/1705-85-7		2.05	0.153 (S)		1.065
1-Methylchrysene	3351-28-8		4.71	0.150 (S)		1.072
C2-Benzo[a]anthracenes/Chrysenes [4]			27.9	0.416 (S)		
5,9-Dimethylchrysene	139493-40-6		7.55	0.416 (S)		1.125
C3-Benzo[a]anthracenes/Chrysenes [4]			7.86	0.213 (S)		
C4-Benzo[a]anthracenes/Chrysenes [5]			4.10	0.240 (S)		
C1-Benzofluoranthenes/Benzopyrenes			41.7	0.294 (S)		
7-Methylbenzo[a]pyrene	63041-77-0		1.57	0.294 (S)		1.108
C2-Benzofluoranthenes/Benzopyrenes			12.0	0.399 (S)		
1,4,6,7-Tetramethylnaphthalene	13764-18-6	NDR	1.68	0.257 (S)	0.19	1.379

(1) Where applicable, custom lab flags have been used on this report; NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = minimum reporting level.
(3) May co-elute with Cyclopenta(cd)pyrene.
(4) May co-elute with Triphenylene.
(5) May co-elute with Dibenz[a,c]anthracene.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ___________[redacted]_________

For Axys Internal Use Only [XSL Template: Pest1A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: PAH_PAH_LO_LPAHF_L30046-2_Form1A_PH8S4781.D_SJ2440870.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

CLIENT SAMPLE NO.
BEN-2
Sample Collection:
05-Sep-2018 09:57

Form 2

POLYAROMATIC HYDROCARBON ANALYSIS REPORT

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	CNRL9078 HORIZON LAKE
Contract No.:	2600	**Lab Sample I.D.:**	L30046-2
Matrix:	SOLID	**Sample Size:**	10.3 g (dry)
Sample Receipt Date:	12-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	02-Oct-2018 **Time:** 04:25:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4781.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4771.D
Concentration Units:	ng absolute	**% Moisture:**	41.9

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO	RRT
Naphthalene d-8		2000	838	41.9	0.09	0.607
2-Methylnaphthalene d-10		1970	929	47.2	0.19	0.754
Biphenyl d-10		2050	1330	64.9		0.867
2,6-Dimethylnaphthalene d-12		2060	1050	51.2	0.74	0.895
Acenaphthylene d-8		2060	1460	71.0	0.15	0.961
Dibenzothiophene d-8		2040	1340	65.6	0.09	0.792
Phenanthrene d-10		1810	1450	80.3	0.15	0.808
Fluoranthene d-10		1990	1760	88.8	0.16	0.971
Benzo[a]anthracene d-12		2030	1860	91.6	0.23	1.164
Chrysene d-12		1960	1750	89.5	0.26	1.169
Benzo[b]fluoranthene d-12		1970	1710	86.7	0.21	0.958
Benzo[k]fluoranthene d-12		2000	1690	84.5	0.19	0.962
Benzo[a]pyrene d-12		2070	1690	81.8	0.20	1.008
Perylene d-12		2150	1810	84.4	0.24	1.024
Dibenzo[a,h]anthracene d-14		1920	1490	77.9	0.24	1.211
Indeno[1,2,3-cd]pyrene d-12		1990	1560	78.3	0.17	1.206
Benzo[ghi]perylene d-12		1980	1490	75.5	0.19	1.238

(1) Where applicable, custom lab flags have been used on this report.
(2) R% = percent recovery.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________[redacted]__________

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SGS AXYS METHOD MLA-021 Rev 12

CLIENT SAMPLE NO.
BEN-3
Sample Collection:
05-Sep-2018 15:10

Form 1A
POLYAROMATIC HYDROCARBON ANALYSIS REPORT

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	CNRL9078 HORIZON LAKE
Contract No.:	2600	**Lab Sample I.D.:**	L30046-3 L
Matrix:	SOLID	**Sample Size:**	12.1 g (dry)
Sample Receipt Date:	12-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	03-Oct-2018 **Time:** 15:19:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4826.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4816.D
Concentration Units:	ng/g (dry weight basis)	**% Moisture:**	45.8

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COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
Naphthalene	91-20-3		0.709	0.057 (S)	0.08	1.007
Acenaphthylene	208-96-8	NDR	0.047	0.045 (S)	0.97	1.003
Acenaphthene	83-32-9		1.16	0.059 (S)	1.25	1.048
2-Methylfluorene	1430-97-3		0.509	0.085 (S)	1.27	0.939
C2 Phenanthrenes/Anthracenes			22.3	0.158 (S)		
Fluorene	86-73-7		1.45	0.059 (S)	1.04	0.844
Phenanthrene	85-01-8		3.76	0.123 (S)	0.19	1.004
Anthracene	120-12-7	NDR	0.263	0.122 (S)	0.37	1.012
C1 Phenanthrenes/Anthracenes			12.4	0.250 (S)		
Fluoranthene	206-44-0		2.82	0.203 (S)	0.21	1.002
Pyrene	129-00-0		5.01	0.199 (S)	0.20	1.032
Benz[a]anthracene [3]	56-55-3	NDR	1.70	0.288 (S)	0.40	1.003
Chrysene [4]	218-01-9		10.1	0.307 (S)	0.36	1.002
Benzo[b]fluoranthene	205-99-2		8.23	0.271 (S)	0.24	1.004
Benzo[j,k]fluoranthenes		NDR	2.45	0.313 (S)	0.29	1.002
Benzo[e]pyrene	192-97-2		9.24	0.409 (S)	0.25	0.996
Benzo[a]pyrene	50-32-8		3.54	0.446 (S)	0.22	1.004
Perylene	198-55-0		118	0.410 (S)	0.21	1.004
Dibenz[a,h]anthracene [5]	53-70-3	NDR	2.07	0.459 (S)	0.72	1.003
Indeno[1,2,3-cd]pyrene	193-39-5		4.80	0.447 (S)	0.20	1.002
Benzo[ghi]perylene	191-24-2		9.03	0.456 (S)	0.21	1.003
2-Methylnaphthalene	91-57-6		1.09	0.047 (S)	0.93	1.009
1-Methylnaphthalene	90-12-0		1.23	0.050 (S)	0.89	1.040
C1-Naphthalenes			2.32	0.047 (S)		
Biphenyl	92-52-4		0.361	0.031 (S)	0.34	1.005
C1-Biphenyls			0.629	0.031 (S)		
C2-Biphenyls			1.11	0.039 (S)		
C2-Naphthalenes			8.60	0.092 (S)		
1,2-Dimethylnaphthalene	573-98-8	NDR	0.284	0.092 (S)	3.55	1.083

s.19(1)

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COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
2,6-Dimethylnaphthalene	581-42-0		1.47	0.075 (S)	0.73	1.011
C3-Naphthalenes			13.9	0.178 (S)		
2,3,6-Trimethylnaphthalene	829-26-5		3.59	0.172 (S)	0.92	1.206
2,3,5-Trimethylnaphthalene	2245-38-7		2.97	0.183 (S)	1.05	1.229
C4-Naphthalenes			12.3	0.159 (S)		
C1-Acenaphthenes			0.153	0.044 (S)		
C1-Fluorenes			3.82	0.085 (S)		
1,7-Dimethylfluorene	442-66-0		0.609	0.218 (S)	0.08	1.034
C2-Fluorenes			11.5	0.218 (S)		
C3-Fluorenes			21.5	0.456 (S)		
Dibenzothiophene	132-65-0	NDR	1.07	0.124 (S)	0.31	1.003
C1-Dibenzothiophenes			6.75	0.312 (S)		
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3		2.03	0.312 (S)	0.71	1.094
C2-Dibenzothiophenes			25.5	0.170 (S)		
2,4-Dimethyldibenzothiophene	31317-18-7	NDR	2.17	0.170 (S)	1.12	1.162
C3-Dibenzothiophenes			39.4	0.249 (S)		
C4-Dibenzothiophenes			46.1	0.271 (S)		
3-Methylphenanthrene	832-71-3		2.27	0.252 (S)	0.60	1.088
2-Methylphenanthrene	2531-84-2		2.38	0.248 (S)	0.59	1.092
2-Methylanthracene	613-12-7	NDR	0.309	0.258 (S)	0.77	1.099
9/4-Methylphenanthrene	883-20-5/832-64-4		4.75	0.252 (S)	0.64	1.107
1-Methylphenanthrene	832-69-9		3.00	0.250 (S)	0.66	1.110
3,6-Dimethylphenanthrene	1576-67-6	NDR	1.78	0.159 (S)	1.12	0.969
2,6-Dimethylphenanthrene	17980-16-4		1.46	0.158 (S)	0.32	0.974
1,7-Dimethylphenanthrene	483-87-4		2.65	0.157 (S)	0.39	0.993
1,8-Dimethylphenanthrene	7372-87-4		1.01	0.158 (S)	0.35	1.007
C3-Phenanthrenes/Anthracenes			23.7	0.367 (S)		
1,2,6-Trimethylphenanthrene	30436-55-6	NDR	1.29	0.367 (S)	1.09	1.076
Retene	483-65-8		24.4	0.901 (S)	1.51	1.083
C4-Phenanthrenes/Anthracenes			107	0.901 (S)		
C1-Fluoranthenes/Pyrenes			25.2	0.316 (S)		
3-Methylfluoranthene/Benzo[a]fluorene	1706-01-0/238-84-6		7.68	0.316 (S)	1.11	1.083
C2-Fluoranthenes/Pyrenes			36.9	0.234 (S)		
C3-Fluoranthenes/Pyrenes			28.2	0.317 (S)		
C4-Fluoranthenes/Pyrenes			13.5	0.301 (S)		
C1-Benzo[a]anthracenes/Chrysenes [4]			26.5	0.257 (S)		
5/6-Methylchrysene	3697-24-3/1705-85-7		2.29	0.259 (S)		1.065
1-Methylchrysene	3351-28-8		5.10	0.254 (S)		1.072
C2-Benzo[a]anthracenes/Chrysenes [4]			34.5	0.581 (S)		
5,9-Dimethylchrysene	139493-40-6		8.70	0.581 (S)		1.126
C3-Benzo[a]anthracenes/Chrysenes [4]			10.6	0.336 (S)		
C4-Benzo[a]anthracenes/Chrysenes [4]			5.52	0.249 (S)		
C1-Benzofluoranthenes/Benzopyrenes			44.3	0.650 (S)		
7-Methylbenzo[a]pyrene	63041-77-0		1.89	0.650 (S)		1.108
C2-Benzofluoranthenes/Benzopyrenes			14.4	0.494 (S)		
1,4,6,7-Tetramethylnaphthalene	13764-18-6	NDR	1.56	0.159 (S)	0.21	1.380

(1) Where applicable, custom lab flags have been used on this report; NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = minimum reporting level.
(3) May co-elute with Cyclopenta(cd)pyrene.
(4) May co-elute with Triphenylene.
(5) May co-elute with Dibenz[a,c]anthracene.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ________[redacted]________

For Axys Internal Use Only [XSL Template: Pest1A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50; Report Filename: PAH_PAH_LO_LPAHF_L30046-3_Form1A_PH8S4826.D_SJ2442008.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

CLIENT SAMPLE NO.
BEN-3
Sample Collection:
05-Sep-2018 15:10

Form 2

POLYAROMATIC HYDROCARBON ANALYSIS REPORT

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	2600	**Project No.**	CNRL9078 HORIZON LAKE
Matrix:	SOLID	**Lab Sample I.D.:**	L30046-3 L
Sample Receipt Date:	12-Sep-2018	**Sample Size:**	12.1 g (dry)
Extraction Date:	27-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Analysis Date:	03-Oct-2018 **Time:** 15:19:00	**Instrument ID:**	LR GC/MS
Extract Volume (uL):	500	**GC Column ID:**	RTX5
Injection Volume (uL):	1.0	**Sample Data Filename:**	**PH8S4826.D**
Dilution Factor:	N/A	**Blank Data Filename:**	PH8S4775.D
Concentration Units:	ng absolute	**Cal. Ver. Data Filename:**	PH8S4816.D
		% Moisture:	45.8

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO	RRT
Naphthalene d-8		2000	919	45.9	0.09	0.607
2-Methylnaphthalene d-10		1970	1010	51.4	0.19	0.754
Biphenyl d-10		2050	1360	66.4		0.867
2,6-Dimethylnaphthalene d-12		2060	1160	56.3	0.75	0.895
Acenaphthylene d-8		2060	1430	69.4	0.15	0.961
Dibenzothiophene d-8		2040	1320	64.8	0.09	0.792
Phenanthrene d-10		1810	1420	78.6	0.15	0.808
Fluoranthene d-10		1990	1650	83.0	0.17	0.971
Benzo[a]anthracene d-12		2030	1600	79.0	0.24	1.164
Chrysene d-12		1960	1530	78.0	0.26	1.169
Benzo[b]fluoranthene d-12		1970	1510	76.8	0.20	0.958
Benzo[k]fluoranthene d-12		2000	1390	69.6	0.20	0.962
Benzo[a]pyrene d-12		2070	1320	63.9	0.20	1.008
Perylene d-12		2150	1520	70.8	0.25	1.024
Dibenzo[a,h]anthracene d-14		1920	948	49.5	0.26	1.211
Indeno[1,2,3-cd]pyrene d-12		1990	1130	56.7	0.18	1.207
Benzo[ghi]perylene d-12		1980	1010	51.1	0.19	1.238

(1) Where applicable, custom lab flags have been used on this report.
(2) R% = percent recovery.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ___________[redacted]_________

For Axys Internal Use Only [XSL Template: Pest2.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: PAH_PAH_LO_LPAHF_L30046-3_Form2_PH8S4826.D_SJ2442008.html; Workgroup: WG65361; Design ID: 526]

SGS AXYS METHOD MLA-021 Rev 12

Form 1A
POLYAROMATIC HYDROCARBON ANALYSIS REPORT

CLIENT SAMPLE NO.
SSP-1
Sample Collection:
05-Sep-2018 10:20

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	CNRL9078 HORIZON LAKE
Contract No.:	2600	**Lab Sample I.D.:**	L30046-4
Matrix:	SOLID	**Sample Size:**	10.6 g (dry)
Sample Receipt Date:	12-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	02-Oct-2018 **Time:** 06:03:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4783.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4771.D
Concentration Units:	ng/g (dry weight basis)	**% Moisture:**	33.3

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
Naphthalene	91-20-3	NDR	0.531	0.074 (S)	0.10	1.007
Acenaphthylene	208-96-8	ND		0.057 (S)		
Acenaphthene	83-32-9		0.840	0.051 (S)	1.23	1.048
2-Methylfluorene	1430-97-3		0.262	0.072 (S)	1.31	0.939
C2 Phenanthrenes/Anthracenes			14.5	0.073 (S)		
Fluorene	86-73-7		0.906	0.042 (S)	1.08	0.844
Phenanthrene	85-01-8		2.41	0.046 (S)	0.20	1.004
Anthracene	120-12-7	NDR	0.166	0.045 (S)	0.34	1.012
C1 Phenanthrenes/Anthracenes			8.56	0.227 (S)		
Fluoranthene	206-44-0		1.79	0.157 (S)	0.21	1.003
Pyrene	129-00-0		3.14	0.154 (S)	0.20	1.033
Benz[a]anthracene [illegible]	56-55-3		1.12	0.193 (S)	0.30	1.003
Chrysene [4]	218-01-9		6.06	0.209 (S)	0.34	1.002
Benzo[b]fluoranthene	205-99-2		5.28	0.140 (S)	0.23	1.004
Benzo[j,k]fluoranthenes			2.12	0.148 (S)	0.24	1.002
Benzo[e]pyrene	192-97-2		5.12	0.184 (S)	0.23	0.996
Benzo[a]pyrene	50-32-8		2.56	0.201 (S)	0.20	1.004
Perylene	198-55-0		82.6	0.196 (S)	0.21	1.004
Dibenz[a,h]anthracene [5]	53-70-3	NDR	1.29	0.193 (S)	0.47	1.003
Indeno[1,2,3-cd]pyrene	193-39-5		3.53	0.254 (S)	0.23	1.002
Benzo[ghi]perylene	191-24-2		6.83	0.227 (S)	0.23	1.003
2-Methylnaphthalene	91-57-6		0.805	0.048 (S)	0.89	1.009
1-Methylnaphthalene	90-12-0		0.889	0.051 (S)	0.86	1.040
C1-Naphthalenes			1.69	0.048 (S)		
Biphenyl	92-52-4		0.296	0.050 (S)	0.33	1.005
C1-Biphenyls			0.579	0.032 (S)		
C2-Biphenyls			1.03	0.037 (S)		
C2-Naphthalenes			6.14	0.112 (S)		
1,2-Dimethylnaphthalene	573-98-8	NDR	0.187	0.112 (S)	3.92	1.082

s.19(1)

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COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
2,6-Dimethylnaphthalene	581-42-0		1.01	0.091 (S)	0.74	1.011
C3-Naphthalenes			9.81	0.115 (S)		
2,3,6-Trimethylnaphthalene	829-26-5		2.53	0.111 (S)	0.93	1.206
2,3,5-Trimethylnaphthalene	2245-38-7		2.04	0.118 (S)	1.04	1.229
C4-Naphthalenes			7.95	0.146 (S)		
C1-Acenaphthenes			0.134	0.041 (S)		
C1-Fluorenes			2.31	0.072 (S)		
1,7-Dimethylfluorene	442-66-0	NDR	0.525	0.185 (S)	0.14	1.034
C2-Fluorenes			7.69	0.185 (S)		
C3-Fluorenes			12.9	0.309 (S)		
Dibenzothiophene	132-65-0	NDR	0.767	0.110 (S)	0.26	1.003
C1-Dibenzothiophenes			4.50	0.166 (S)		
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3		1.23	0.166 (S)	0.83	1.095
C2-Dibenzothiophenes			17.0	0.205 (S)		
2,4-Dimethyldibenzothiophene	31317-18-7	NDR	1.61	0.205 (S)	0.81	1.163
C3-Dibenzothiophenes			26.6	0.163 (S)		
C4-Dibenzothiophenes			29.0	0.198 (S)		
3-Methylphenanthrene	832-71-3		1.56	0.229 (S)	0.62	1.087
2-Methylphenanthrene	2531-84-2		1.54	0.225 (S)	0.60	1.092
2-Methylanthracene	613-12-7		0.238	0.235 (S)	0.53	1.098
9/4-Methylphenanthrene	883-20-5/832-64-4		3.25	0.229 (S)	0.67	1.106
1-Methylphenanthrene	832-69-9		1.97	0.227 (S)	0.65	1.110
3,6-Dimethylphenanthrene	1576-67-6	NDR	1.31	0.074 (S)	1.09	0.969
2,6-Dimethylphenanthrene	17980-16-4		0.846	0.073 (S)	0.30	0.975
1,7-Dimethylphenanthrene	483-87-4	NDR	1.74	0.073 (S)	0.41	0.993
1,8-Dimethylphenanthrene	7372-87-4		0.660	0.073 (S)	0.36	1.007
C3-Phenanthrenes/Anthracenes			16.1	0.316 (S)		
1,2,6-Trimethylphenanthrene	30436-55-6	NDR	0.721	0.316 (S)	1.03	1.076
Retene	483-65-8		10.5	0.950 (S)	1.45	1.083
C4-Phenanthrenes/Anthracenes			68.0	0.950 (S)		
C1-Fluoranthenes/Pyrenes			16.2	0.297 (S)		
3-Methylfluoranthene/Benzo[a]fluorene	1706-01-0/238-84-6		4.97	0.297 (S)	1.03	1.083
C2-Fluoranthenes/Pyrenes			22.3	0.158 (S)		
C3-Fluoranthenes/Pyrenes			18.6	0.191 (S)		
C4-Fluoranthenes/Pyrenes			8.93	0.208 (S)		
C1-Benzo[a]anthracenes/Chrysenes [4]			16.7	0.257 (S)		
5/6-Methylchrysene	3697-24-3/1705-85-7		1.53	0.260 (S)		1.065
1-Methylchrysene	3351-28-8		3.28	0.255 (S)		1.072
C2-Benzo[a]anthracenes/Chrysenes [4]			19.9	0.464 (S)		
5,9-Dimethylchrysene	139493-40-6		5.56	0.464 (S)		1.126
C3-Benzo[a]anthracenes/Chrysenes [4]			5.59	0.146 (S)		
C4-Benzo[a]anthracenes/Chrysenes [4]			2.93	0.197 (S)		
C1-Benzofluoranthenes/Benzopyrenes			32.6	0.273 (S)		
7-Methylbenzo[a]pyrene	63041-77-0		1.14	0.273 (S)		1.108
C2-Benzofluoranthenes/Benzopyrenes			8.99	0.646 (S)		
1,4,6,7-Tetramethylnaphthalene	13764-18-6	NDR	1.13	0.146 (S)	0.19	1.379

(1) Where applicable, custom lab flags have been used on this report; ND = not detected at RL; NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = minimum reporting level.
(3) May co-elute with Cyclopenta(cd)pyrene.
(4) May co-elute with Triphenylene.
(5) May co-elute with Dibenz[a,c]anthracene.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ___________ [redacted] ________

For Axys Internal Use Only [XSL Template: Pest1A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: PAH_PAH_LO_LPAHF_L30046-4_Form1A_PH8S4783.D_SJ2440872.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

CLIENT SAMPLE NO.
SSP-1
Sample Collection:
05-Sep-2018 10:20

Form 2

POLYAROMATIC HYDROCARBON ANALYSIS REPORT

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Project No.			CNRL9078 HORIZON LAKE
Contract No.:	2600	**Lab Sample I.D.:**	L30046-4
Matrix:	SOLID	**Sample Size:**	10.6 g (dry)
Sample Receipt Date:	12-Sep-2018	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	02-Oct-2018 **Time:** 06:03:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4783.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4771.D
Concentration Units:	ng absolute	**% Moisture:**	33.3

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO	RRT
Naphthalene d-8		2000	905	45.3	0.09	0.607
2-Methylnaphthalene d-10		1970	974	49.4	0.19	0.754
Biphenyl d-10		2050	1290	63.2		0.867
2,6-Dimethylnaphthalene d-12		2060	1120	54.6	0.74	0.895
Acenaphthylene d-8		2060	1420	68.7	0.15	0.961
Dibenzothiophene d-8		2040	1360	67.1	0.09	0.792
Phenanthrene d-10		1810	1410	78.2	0.15	0.808
Fluoranthene d-10		1990	1690	85.0	0.16	0.970
Benzo[a]anthracene d-12		2030	1730	85.4	0.23	1.164
Chrysene d-12		1960	1640	83.7	0.26	1.169
Benzo[b]fluoranthene d-12		1970	1650	83.9	0.20	0.958
Benzo[k]fluoranthene d-12		2000	1610	80.7	0.20	0.962
Benzo[a]pyrene d-12		2070	1630	78.8	0.20	1.008
Perylene d-12		2150	1750	81.5	0.24	1.024
Dibenzo[a,h]anthracene d-14		1920	1470	76.8	0.23	1.211
Indeno[1,2,3-cd]pyrene d-12		1990	1540	77.2	0.17	1.206
Benzo[ghi]perylene d-12		1980	1510	76.2	0.19	1.238

(1) Where applicable, custom lab flags have been used on this report.
(2) R% = percent recovery.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________ [redacted] __________

For Axys Internal Use Only [XSL Template: Pest2.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: PAH PAH LO_LPAHF_L30046-4_Form2_PH8S4783.D_SJ2440872.html; Workgroup: WG65361; Design ID: 526]

SGS AXYS METHOD MLA-021 Rev 12

CLIENT SAMPLE NO.
Lab Blank
Sample Collection:
N/A

Form 1A
POLYAROMATIC HYDROCARBON ANALYSIS REPORT

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	2600	**Project No.**	N/A
		Lab Sample I.D.:	WG65361-101
Matrix:	SOLID	**Sample Size:**	10.0 g
Sample Receipt Date:	N/A	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	01-Oct-2018 **Time:** 23:31:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4775.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4771.D

Concentration Units: ng/g

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
Naphthalene	91-20-3	NDR	0.094	0.068 (S)	0.13	1.006
Acenaphthylene	208-96-8	ND		0.029 (S)		
Acenaphthene	83-32-9	ND		0.043 (S)		
2-Methylfluorene	1430-97-3	ND		0.053 (S)		
C2 Phenanthrenes/Anthracenes			0.059	0.023 (S)		
Fluorene	86-73-7	ND		0.038 (S)		
Phenanthrene	85-01-8	NDR	0.063	0.028 (S)	0.14	1.004
Anthracene	120-12-7	ND		0.027 (S)		
C1 Phenanthrenes/Anthracenes		ND		0.068 (S)		
Fluoranthene	206-44-0	NDR	0.033	0.015 (S)	0.29	1.002
Pyrene	129-00-0	NDR	0.057	0.014 (S)	0.16	1.032
Benz[a]anthracene [3]	56-55-3	NDR	0.017	0.015 (S)	1.00	1.003
Chrysene [4]	218-01-9	NDR	0.035	0.018 (S)	0.88	1.002
Benzo[b]fluoranthene	205-99-2	ND		0.035 (S)		
Benzo[j,k]fluoranthenes		ND		0.040 (S)		
Benzo[e]pyrene	192-97-2	ND		0.052 (S)		
Benzo[a]pyrene	50-32-8	ND		0.057 (S)		
Perylene	198-55-0	ND		0.064 (S)		
Dibenz[a,h]anthracene [5]	53-70-3	NDR	0.100	0.045 (S)	0.23	1.004
Indeno[1,2,3-cd]pyrene	193-39-5	NDR	0.103	0.042 (S)	2.03	1.004
Benzo[ghi]perylene	191-24-2	ND		0.041 (S)		
2-Methylnaphthalene	91-57-6		0.059	0.053 (S)	0.73	1.009
1-Methylnaphthalene	90-12-0	ND		0.056 (S)		
C1-Naphthalenes			0.059	0.053 (S)		
Biphenyl	92-52-4	NDR	0.044	0.034 (S)	0.35	1.005
C1-Biphenyls			0.281	0.034 (S)		
C2-Biphenyls			0.304	0.045 (S)		
C2-Naphthalenes		ND		0.063 (S)		
1,2-Dimethylnaphthalene	573-98-8	ND		0.063 (S)		

s.19(1)

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COMPOUND	CAS NO.	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO	RRT
2,6-Dimethylnaphthalene	581-42-0	ND		0.051 (S)		
C3-Naphthalenes		ND		0.052 (S)		
2,3,6-Trimethylnaphthalene	829-26-5	ND		0.051 (S)		
2,3,5-Trimethylnaphthalene	2245-38-7	ND		0.054 (S)		
C4-Naphthalenes		ND		0.035 (S)		
C1-Acenaphthenes		ND		0.037 (S)		
C1-Fluorenes		ND		0.053 (S)		
1,7-Dimethylfluorene	442-66-0	ND		0.088 (S)		
C2-Fluorenes		ND		0.088 (S)		
C3-Fluorenes		ND		0.146 (S)		
Dibenzothiophene	132-65-0	ND		0.041 (S)		
C1-Dibenzothiophenes		ND		0.044 (S)		
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3	ND		0.044 (S)		
C2-Dibenzothiophenes			0.157	0.049 (S)		
2,4-Dimethyldibenzothiophene	31317-18-7	NDR	0.085	0.049 (S)	0.12	1.161
C3-Dibenzothiophenes		ND		0.042 (S)		
C4-Dibenzothiophenes		ND		0.036 (S)		
3-Methylphenanthrene	832-71-3	ND		0.068 (S)		
2-Methylphenanthrene	2531-84-2	ND		0.067 (S)		
2-Methylanthracene	613-12-7	ND		0.070 (S)		
9/4-Methylphenanthrene	883-20-5/832-64-4	ND		0.068 (S)		
1-Methylphenanthrene	832-69-9	ND		0.068 (S)		
3,6-Dimethylphenanthrene	1576-67-6	ND		0.024 (S)		
2,6-Dimethylphenanthrene	17980-16-4	ND		0.023 (S)		
1,7-Dimethylphenanthrene	483-87-4	ND		0.023 (S)		
1,8-Dimethylphenanthrene	7372-87-4	ND		0.023 (S)		
C3-Phenanthrenes/Anthracenes		ND		0.027 (S)		
1,2,6-Trimethylphenanthrene	30436-55-6	ND		0.027 (S)		
Retene	483-65-8	ND		0.051 (S)		
C4-Phenanthrenes/Anthracenes		ND		0.051 (S)		
C1-Fluoranthenes/Pyrenes		ND		0.022 (S)		
3-Methylfluoranthene/Benzo[a]fluorene	1706-01-0/238-84-6	ND		0.022 (S)		
C2-Fluoranthenes/Pyrenes		ND		0.022 (S)		
C3-Fluoranthenes/Pyrenes		ND		0.020 (S)		
C4-Fluoranthenes/Pyrenes		ND		0.018 (S)		
C1-Benzo[a]anthracenes/Chrysenes [4]			0.033	0.030 (S)		
5/6-Methylchrysene	3697-24-3/1705-85-7	ND		0.031 (S)		
1-Methylchrysene	3351-28-8	ND		0.030 (S)		
C2-Benzo[a]anthracenes/Chrysenes [4]		ND		0.048 (S)		
5,9-Dimethylchrysene	139493-40-6	ND		0.048 (S)		
C3-Benzo[a]anthracenes/Chrysenes [4]		ND		0.048 (S)		
C4-Benzo[a]anthracenes/Chrysenes [4]		ND		0.053 (S)		
C1-Benzofluoranthenes/Benzopyrenes		ND		0.072 (S)		
7-Methylbenzo[a]pyrene	63041-77-0	ND		0.072 (S)		
C2-Benzofluoranthenes/Benzopyrenes		ND		0.068 (S)		
1,4,6,7-Tetramethylnaphthalene	13764-18-6	ND		0.035 (S)		

(1) Where applicable, custom lab flags have been used on this report; ND = not detected at RL; NDR = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = minimum reporting level.
(3) May co-elute with Cyclopenta(cd)pyrene.
(4) May co-elute with Triphenylene.
(5) May co-elute with Dibenz[a,c]anthracene.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: [redacted]

For Axys Internal Use Only [XSL Template: Pest1A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: PAH_PAH_LO_LPAHF_WG65361-101_Form1A_PH8S4775.D_SJ2440867.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

CLIENT SAMPLE NO.
Lab Blank
Sample Collection:
N/A

Form 2

POLYAROMATIC HYDROCARBON ANALYSIS REPORT

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	2600	**Project No.**	N/A
		Lab Sample I.D.:	WG65361-101
Matrix:	SOLID	**Sample Size:**	10.0 g
Sample Receipt Date:	N/A	**Initial Calibration Date:**	28-Sep-2018
Extraction Date:	27-Sep-2018	**Instrument ID:**	LR GC/MS
Analysis Date:	01-Oct-2018 **Time:** 23:31:00	**GC Column ID:**	RTX5
Extract Volume (uL):	500	**Sample Data Filename:**	**PH8S4775.D**
Injection Volume (uL):	1.0	**Blank Data Filename:**	PH8S4775.D
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	PH8S4771.D
Concentration Units:	ng absolute		

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with CALA accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO	RRT
Naphthalene d-8		2000	1120	55.8	0.09	0.607
2-Methylnaphthalene d-10		1970	1150	58.5	0.19	0.755
Biphenyl d-10		2050	1290	63.2		0.867
2,6-Dimethylnaphthalene d-12		2060	1260	61.3	0.74	0.895
Acenaphthylene d-8		2060	1310	63.6	0.15	0.961
Dibenzothiophene d-8		2040	1300	64.0	0.09	0.792
Phenanthrene d-10		1810	1340	74.4	0.14	0.808
Fluoranthene d-10		1990	1760	88.4	0.17	0.971
Benzo[a]anthracene d-12		2030	1740	85.6	0.23	1.164
Chrysene d-12		1960	1730	88.1	0.26	1.169
Benzo[b]fluoranthene d-12		1970	1750	88.6	0.21	0.958
Benzo[k]fluoranthene d-12		2000	1770	88.5	0.19	0.962
Benzo[a]pyrene d-12		2070	1750	84.8	0.20	1.008
Perylene d-12		2150	1820	84.6	0.24	1.024
Dibenzo[a,h]anthracene d-14		1920	1700	88.7	0.26	1.211
Indeno[1,2,3-cd]pyrene d-12		1990	1700	85.2	0.18	1.206
Benzo[ghi]perylene d-12		1980	1750	88.6	0.19	1.238

(1) Where applicable, custom lab flags have been used on this report.
(2) R% = percent recovery.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ___________] [redacted] __________

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Report Filename: PAH_PAH_LO_LPAHF_WG65361-101_Form2_PH8S4775.D_SJ2440867.html; Workgroup: WG65361; Design ID: 526]

SGS AXYS METHOD MLA-021 Rev 12

Form 8A

POLYAROMATIC HYDROCARBON ONGOING PRECISION AND RECOVERY (OPR)

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	2600	**OPR Data Filename:**	**PH8S4772.D**
Matrix:	SOLID	**Lab Sample I.D.:**	WG65361-102
Extraction Date:	27-Sep-2018	**Analysis Date:**	01-Oct-2018 **Time:** 21:05:00

ALL CONCENTRATIONS REPORTED ON THIS FORM ARE CONCENTRATIONS IN EXTRACT, BASED ON 100 uL EXTRACT.

COMPOUND	CAS NO.	LAB FLAG [1]	ION ABUND. RATIO	SPIKE CONC. (ng/mL)	CONC. FOUND (ng/mL)	OPR CONC. LIMITS (ng/mL)	% RECOVERY
Naphthalene	91-20-3		0.07	19700	19700	13800 - 25600	99.6
Acenaphthylene	208-96-8		0.20	19700	19800	13800 - 27500	101
Acenaphthene	83-32-9		1.15	20100	20700	14000 - 26100	103
2-Methylfluorene	1430-97-3		1.27	20000	20100	10000 - 30000	101
Fluorene	86-73-7		0.99	19700	18200	11800 - 27500	92.7
Phenanthrene	85-01-8		0.19	20200	20300	14100 - 26200	101
Anthracene	120-12-7		0.19	20100	20300	14000 - 26100	101
Fluoranthene	206-44-0		0.20	19800	21100	13900 - 25700	107
Pyrene	129-00-0		0.21	19800	20800	13900 - 25700	105
Benz[a]anthracene	56-55-3		0.27	20100	20400	14100 - 26200	102
Chrysene	218-01-9		0.30	20100	20300	14100 - 26100	101
Benzo[b]fluoranthene	205-99-2		0.22	20100	20200	14100 - 26200	100
Benzo[j,k]fluoranthenes			0.22	20200	20300	14100 - 26200	101
Benzo[e]pyrene	192-97-2		0.22	20000	20400	14000 - 26000	102
Benzo[a]pyrene	50-32-8		0.22	20000	20500	14000 - 26000	103
Perylene	198-55-0		0.22	20000	20700	14000 - 26000	103
Dibenz[a,h]anthracene	53-70-3		0.16	19700	19600	13800 - 25600	99.5
Indeno[1,2,3-cd]pyrene	193-39-5		0.20	20100	20600	14100 - 26200	102
Benzo[ghi]perylene	191-24-2		0.21	19700	20000	13800 - 25600	102
2-Methylnaphthalene	91-57-6		0.89	20000	20300	14000 - 26000	102
1-Methylnaphthalene	90-12-0		0.92	20000	20500	14000 - 26000	103
Biphenyl	92-52-4		0.29	20100	20400	14000 - 26100	102
1,2-Dimethylnaphthalene	573-98-8		1.28	20000	20900	12000 - 28000	104
2,6-Dimethylnaphthalene	581-42-0		0.69	20000	20500	14000 - 26000	102
2,3,6-Trimethylnaphthalene	829-26-5		0.90	20000	22500	10000 - 30000	113
2,3,5-Trimethylnaphthalene	2245-38-7		0.90	20000	22400	10000 - 30000	112
1,7-Dimethylfluorene	442-66-0		0.08	20000	22400	10000 - 30000	112
Dibenzothiophene	132-65-0		0.08	20000	20200	12000 - 28000	101
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3		0.71	20000	20100	10000 - 30000	101
2-Methylphenanthrene	2531-84-2		0.58	20000	21500	10000 - 30000	107
2-Methylanthracene	613-12-7		0.50	20000	21700	10000 - 30000	108
1-Methylphenanthrene	832-69-9		0.60	20000	22100	10000 - 30000	110
3,6-Dimethylphenanthrene	1576-67-6		0.36	20000	20800	9990 - 30000	104
1,7-Dimethylphenanthrene	483-87-4		0.34	20100	21500	10000 - 30100	107
1,2,6-Trimethylphenanthrene	30436-55-6		0.59	23300	26300	11700 - 35000	113

s.19(1)

COMPOUND	CAS NO.	LAB FLAG [1]	ION ABUND. RATIO	SPIKE CONC. (ng/mL)	CONC. FOUND (ng/mL)	OPR CONC. LIMITS (ng/mL)	% RECOVERY
Retene	483-65-8		1.64	20000	22100	9990 - 30000	111
5/6-Methylchrysene	3697-24-3/1705-85-7			20000	20000	10000 - 30000	99.9
1-Methylchrysene	3351-28-8			20000	20900	10000 - 30000	104
7-Methylbenzo[a]pyrene	63041-77-0			20000	21200	9980 - 30000	106
1,4,6,7-Tetramethylnaphthalene	13764-18-6		0.03	20000	23800	9980 - 39900	119

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ____________[redacted]____________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

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s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

Form 8B

POLYAROMATIC HYDROCARBON ONGOING PRECISION AND RECOVERY (OPR)

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	2600	**OPR Data Filename:**	**PH8S4772.D**
Matrix:	SOLID	**Lab Sample I.D.:**	WG65361-102
Extraction Date:	27-Sep-2018	**Analysis Date:**	01-Oct-2018 **Time:** 21:05:00

ALL CONCENTRATIONS REPORTED ON THIS FORM ARE CONCENTRATIONS IN EXTRACT, BASED ON 100 uL EXTRACT.

LABELED COMPOUND	CAS NO.	LAB FLAG [1]	ION ABUND. RATIO	SPIKE CONC. (ng/mL)	CONC. FOUND (ng/mL)	OPR CONC. LIMITS (ng/mL)	% RECOVERY
Naphthalene d-8	1146-65-2		0.09	20000	12500	3000-26000	62.5
2-Methylnaphthalene d-10	7297-45-2		0.19	19700	13400	3940-25600	68.0
Biphenyl d-10	1486-01-7			20500	14900	3070-26600	72.9
2,6-Dimethylnaphthalene d-12	350820-12-1		0.74	20600	15000	4110-26700	73.2
Acenaphthylene d-8	93951-97-4		0.15	20600	15400	4120-26800	74.6
Dibenzothiophene d-8	33262-29-2		0.09	20400	15000	6110-26500	73.5
Phenanthrene d-10	1517-22-2		0.14	18100	14900	5420-23500	82.7
Fluoranthene d-10	93951-69-0		0.17	19900	17500	5960-25800	88.1
Benzo[a]anthracene d-12	1718-53-2		0.23	20300	19200	6090-26400	94.6
Chrysene d-12	1719-03-5		0.26	19600	18800	5880-25500	96.2
Benzo[b]fluoranthene d-12	93951-98-5		0.20	19700	17900	5910-25600	90.7
Benzo[k]fluoranthene d-12	93952-01-3		0.20	20000	18500	6000-26000	92.6
Benzo[a]pyrene d-12	63466-71-7		0.20	20700	18900	6210-26900	91.1
Perylene d-12	1520-96-3		0.24	21500	19300	6450-28000	89.6
Dibenzo[a,h]anthracene d-14	13250-98-1		0.25	19200	18700	5750-24900	97.9
Indeno[1,2,3-cd]pyrene d-12	203578-33-0		0.18	19900	18200	5970-25900	91.6
Benzo[ghi]perylene d-12	93951-66-7		0.19	19800	18500	5940-25700	93.7

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ____________ [redacted] ____________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

For Axys Internal Use Only [XSL Template: Pest8B.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50; Report Filename: PAH_PAH_LO_LPAHF_WG65361-102_Form8B_SJ2440865.html; Workgroup: WG65361; Design ID: 526]

SGS AXYS METHOD MLA-021 Rev 12

Form 3A

POLYAROMATIC HYDROCARBON INITIAL CALIBRATION RELATIVE RESPONSES

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	CS0 Data Filename:	N/A
Instrument ID:	LR GC/MS	CS1 Data Filename:	PH8S4734.D
GC Column ID:	RTX5	CS2 Data Filename:	PH8S4735.D
		CS3 Data Filename:	PH8S4736.D
		CS4 Data Filename:	PH8S4738.D
		CS5 Data Filename:	PH8S4737.D
		CS6 Data Filename:	N/A

COMPOUND	LAB FLAG 1	RELATIVE RESPONSE (RR) CS0	CS1	CS2	CS3	CS4	CS5	CS6	MEAN RR	CV (%RSD)2
Naphthalene			1.23	1.17	1.22	1.17	1.15		1.19	2.87
Acenaphthylene			1.24	1.19	1.24	1.20	1.18		1.21	2.22
Acenaphthene			0.69	0.65	0.68	0.67	0.65		0.67	2.89
2-Methylfluorene			0.50	0.47	0.50	0.49	0.49		0.49	2.34
Fluorene			0.74	0.70	0.73	0.71	0.69		0.71	2.73
Phenanthrene			1.11	1.04	1.10	1.05	1.03		1.07	3.26
Anthracene			1.11	1.06	1.11	1.06	1.06		1.08	2.67
Fluoranthene			1.32	1.24	1.31	1.27	1.23		1.28	3.23
Pyrene			1.37	1.27	1.33	1.30	1.26		1.30	3.45
Benz[a]anthracene			1.30	1.21	1.29	1.26	1.24		1.26	3.01
Chrysene			1.29	1.22	1.29	1.24	1.22		1.25	2.62
Benzo[b]fluoranthene			1.51	1.39	1.44	1.39	1.37		1.42	4.00
Benzo[j,k]fluoranthenes			1.31	1.27	1.33	1.30	1.27		1.30	1.95
Benzo[e]pyrene			1.44	1.38	1.47	1.45	1.41		1.43	2.41
Benzo[a]pyrene			1.30	1.26	1.34	1.33	1.34		1.31	2.78
Perylene			1.36	1.29	1.40	1.40	1.40		1.37	3.58
Dibenz[a,h]anthracene			1.26	1.23	1.29	1.28	1.27		1.27	1.88
Indeno[1,2,3-cd]pyrene			1.23	1.19	1.23	1.20	1.19		1.21	1.65
Benzo[ghi]perylene			1.22	1.17	1.23	1.21	1.20		1.21	1.78
2-Methylnaphthalene			1.22	1.17	1.23	1.18	1.17		1.19	2.50
1-Methylnaphthalene			1.16	1.09	1.16	1.12	1.10		1.13	3.04
Biphenyl			1.16	1.08	1.13	1.09	1.07		1.11	3.11
C1-Biphenyls			1.16	1.08	1.13	1.09	1.07		1.11	3.11
C2-Biphenyls			1.16	1.08	1.13	1.09	1.07		1.11	3.11
1,2-Dimethylnaphthalene			1.02	0.96	0.99	0.95	0.93		0.97	3.73
2,6-Dimethylnaphthalene			1.23	1.15	1.23	1.18	1.16		1.19	2.89
C3-Naphthalenes			1.19	1.15	1.20	1.17	1.17		1.17	1.51
2,3,6-Trimethylnaphthalene			1.22	1.19	1.24	1.20	1.20		1.21	1.66
2,3,5-Trimethylnaphthalene			1.16	1.12	1.15	1.13	1.13		1.14	1.48
C4-Naphthalenes			1.24	1.15	1.20	1.18	1.18		1.19	2.73
C1-Acenaphthenes			0.69	0.65	0.68	0.67	0.65		0.67	2.89
C1-Fluorenes			0.50	0.47	0.50	0.49	0.49		0.49	2.34
1,7-Dimethylfluorene			0.46	0.42	0.46	0.45	0.45		0.45	3.46
C2-Fluorenes			0.46	0.42	0.46	0.45	0.45		0.45	3.46
C3-Fluorenes			0.46	0.42	0.46	0.45	0.45		0.45	3.46
Dibenzothiophene			1.23	1.16	1.21	1.17	1.14		1.18	3.19
2/3-Methyldibenzothiophenes			0.86	0.79	0.85	0.83	0.82		0.83	3.13
C2-Dibenzothiophenes			0.66	0.65	0.69	0.70	0.67		0.67	2.89

s.19(1)

COMPOUND	LAB FLAG 1	RELATIVE RESPONSE (RR) CS0	CS1	CS2	CS3	CS4	CS5	CS6	MEAN RR	CV (%RSD)[2]
2,4-Dimethyldibenzothiophene			0.66	0.65	0.69	0.70	0.67		0.67	2.89
C3-Dibenzothiophenes			0.66	0.65	0.69	0.70	0.67		0.67	2.89
C4-Dibenzothiophenes			0.66	0.65	0.69	0.70	0.67		0.67	2.89
3-Methylphenanthrene			0.79	0.74	0.80	0.79	0.78		0.78	2.72
2-Methylphenanthrene			0.81	0.76	0.81	0.80	0.79		0.79	2.68
2-Methylanthracene			0.77	0.72	0.78	0.76	0.78		0.76	3.24
9/4-Methylphenanthrene			0.79	0.74	0.80	0.79	0.78		0.78	2.72
1-Methylphenanthrene			0.79	0.75	0.81	0.80	0.78		0.79	2.69
3,6-Dimethylphenanthrene			0.74	0.69	0.73	0.71	0.71		0.72	2.47
2,6-Dimethylphenanthrene			0.73	0.70	0.74	0.72	0.72		0.72	2.17
1,7-Dimethylphenanthrene			0.73	0.71	0.75	0.73	0.72		0.73	2.07
1,8-Dimethylphenanthrene			0.73	0.70	0.74	0.72	0.72		0.72	2.17
C3-Phenanthrenes/Anthracenes			0.68	0.63	0.67	0.68	0.66		0.67	2.96
1,2,6-Trimethylphenanthrene			0.68	0.63	0.67	0.68	0.66		0.67	2.96
Retene			0.27	0.24	0.26	0.25	0.25		0.25	4.38
C4-Phenanthrenes/Anthracenes			0.27	0.24	0.26	0.25	0.25		0.25	4.38
3-Methylfluoranthene/Benzo[a] fluorene			0.76	0.71	0.77	0.77	0.75		0.75	3.14
C2-Fluoranthenes/Pyrenes			0.76	0.71	0.77	0.77	0.75		0.75	3.14
C3-Fluoranthenes/Pyrenes			0.76	0.71	0.77	0.77	0.75		0.75	3.14
C4-Fluoranthenes/Pyrenes			0.76	0.71	0.77	0.77	0.75		0.75	3.14
C1-Benzo[a] anthracenes/Chrysenes			1.04	0.96	1.01	1.01	1.00		1.00	2.85
5/6-Methylchrysene			1.06	0.97	0.99	0.98	0.96		0.99	4.04
1-Methylchrysene			1.01	0.95	1.03	1.04	1.03		1.01	3.49
C2-Benzo[a] anthracenes/Chrysenes			0.74	0.70	0.76	0.76	0.77		0.75	3.64
5,9-Dimethylchrysene			0.74	0.70	0.76	0.76	0.77		0.75	3.64
C3-Benzo[a] anthracenes/Chrysenes			0.74	0.70	0.76	0.76	0.77		0.75	3.64
C4-Benzo[a] anthracenes/Chrysenes			0.74	0.70	0.76	0.76	0.77		0.75	3.64
C1-Benzofluoranthenes/Benzopyrenes			0.97	0.89	0.98	0.98	1.01		0.97	4.68
7-Methylbenzo[a]pyrene			0.97	0.89	0.98	0.98	1.01		0.97	4.68
C2-Benzofluoranthenes/Benzopyrenes			0.97	0.89	0.98	0.98	1.01		0.97	4.68
1,4,6,7-Tetramethylnaphthalene			1.24	1.15	1.20	1.18	1.18		1.19	2.73

(1) Where applicable, custom lab flags have been used on this report.
(2) QC limit is 20% for native compounds with a labeled analog, 35% for those without a labeled analog.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: [redacted]

For Axys Internal Use Only [XSL Template: Form3A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50; Report Filename: GENERIC-SPECS_PAH_LO_28-Sep-2018_PH8S__Form3A_GS77951.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

Form 3B
POLYAROMATIC HYDROCARBON INITIAL CALIBRATION RELATIVE RESPONSES

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	**CS0 Data Filename:**	N/A
		CS1 Data Filename:	PH8S4734.D
Instrument ID:	LR GC/MS	**CS2 Data Filename:**	PH8S4735.D
GC Column ID:	RTX5	**CS3 Data Filename:**	PH8S4736.D
		CS4 Data Filename:	PH8S4738.D
		CS5 Data Filename:	PH8S4737.D
		CS6 Data Filename:	N/A

		RELATIVE RESPONSE (RR)								
LABELED COMPOUND	**LAB FLAG** [1]	**CS0**	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**MEAN RR**	**CV (%RSD)**[2]
Naphthalene d-8			1.44	1.45	1.47	1.45	1.46		1.45	0.89
2-Methylnaphthalene d-10			1.00	1.00	1.01	1.00	1.01		1.00	0.53
Biphenyl d-10			1.41	1.42	1.43	1.41	1.42		1.41	0.57
2,6-Dimethylnaphthalene d-12			0.92	0.93	0.93	0.92	0.93		0.92	0.61
Acenaphthylene d-8			1.76	1.76	1.78	1.72	1.78		1.76	1.26
Dibenzothiophene d-8			0.88	0.89	0.87	0.85	0.89		0.88	1.95
Phenanthrene d-10			0.98	1.00	0.98	0.95	0.99		0.98	1.88
Fluoranthene d-10			0.94	0.95	0.96	0.94	0.96		0.95	1.01
Benzo[a]anthracene d-12			0.87	0.85	0.88	0.89	0.88		0.87	1.77
Chrysene d-12			0.85	0.84	0.87	0.88	0.86		0.86	1.85
Benzo[b]fluoranthene d-12			0.95	0.96	0.95	0.95	0.97		0.96	0.75
Benzo[k]fluoranthene d-12			0.97	0.97	0.99	0.98	1.01		0.99	1.68
Benzo[a]pyrene d-12			0.85	0.86	0.86	0.85	0.87		0.86	1.15
Perylene d-12			0.85	0.86	0.86	0.85	0.87		0.86	0.93
Dibenzo[a,h]anthracene d-14			0.77	0.80	0.78	0.71	0.73		0.76	4.43
Indeno[1,2,3-cd]pyrene d-12			0.92	0.94	0.92	0.86	0.87		0.90	3.77
Benzo[ghi]perylene d-12			1.01	1.02	1.01	0.93	0.95		0.98	4.10

(1) Where applicable, custom lab flags have been used on this report.
(2) QC limit is 35% for labeled compounds.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ____________ [redacted] ____________

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Report Filename: GENERIC-SPECS_PAH_LO_28-Sep-2018_PH8S__Form3B_GS77951.html; Workgroup: WG65361; Design ID: 526]

SGS AXYS METHOD MLA-021 Rev 12

Form 3C

POLYAROMATIC HYDROCARBON INITIAL CALIBRATION ION ABUNDANCE RATIOS

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	**CS0 Data Filename:**	N/A
		CS1 Data Filename:	PH8S4734.D
Instrument ID:	LR GC/MS	**CS2 Data Filename:**	PH8S4735.D
GC Column ID:	RTX5	**CS3 Data Filename:**	PH8S4736.D
		CS4 Data Filename:	PH8S4738.D
		CS5 Data Filename:	PH8S4737.D
		CS6 Data Filename:	N/A

COMPOUND	LAB FLAG [1]	M/Z's FORMING RATIO	ION ABUNDANCE RATIO CS0	CS1	CS2	CS3	CS4	CS5	CS6
Naphthalene		128,102		0.08	0.08	0.07	0.08	0.08	
Acenaphthylene		152,151		0.20	0.20	0.20	0.20	0.20	
Acenaphthene		154,153		1.14	1.16	1.16	1.15	1.14	
2-Methylfluorene		180,165		1.31	1.29	1.29	1.28	1.27	
Fluorene		166,165		0.99	0.99	0.99	0.99	0.98	
Phenanthrene		178,176		0.20	0.19	0.19	0.19	0.19	
Anthracene		178,176		0.19	0.18	0.19	0.19	0.19	
Fluoranthene		202,200		0.21	0.20	0.21	0.21	0.20	
Pyrene		202,200		0.20	0.20	0.21	0.21	0.21	
Benz[a]anthracene		228,226		0.26	0.27	0.27	0.27	0.27	
Chrysene		228,226		0.30	0.30	0.30	0.30	0.30	
Benzo[b]fluoranthene		252,253		0.22	0.21	0.21	0.22	0.22	
Benzo[j,k]fluoranthenes		252,253		0.22	0.22	0.21	0.22	0.22	
Benzo[e]pyrene		252,253		0.23	0.21	0.21	0.21	0.22	
Benzo[a]pyrene		252,253		0.24	0.22	0.21	0.21	0.22	
Perylene		252,253		0.23	0.22	0.21	0.22	0.22	
Dibenz[a,h]anthracene		278,139		0.16	0.16	0.16	0.16	0.16	
Indeno[1,2,3-cd]pyrene		276,138		0.23	0.21	0.20	0.20	0.20	
Benzo[ghi]perylene		276,138		0.21	0.22	0.21	0.22	0.22	
2-Methylnaphthalene		142,141		0.89	0.90	0.91	0.90	0.89	
1-Methylnaphthalene		142,141		0.90	0.94	0.93	0.93	0.92	
Biphenyl		154,152		0.29	0.29	0.29	0.29	0.29	
1,2-Dimethylnaphthalene		156,141		1.25	1.24	1.28	1.29	1.30	
2,6-Dimethylnaphthalene		156,141		0.69	0.70	0.69	0.69	0.70	
2,3,6-Trimethylnaphthalene		170,155		0.91	0.90	0.90	0.91	0.91	
2,3,5-Trimethylnaphthalene		170,155		0.90	0.89	0.91	0.90	0.90	
1,7-Dimethylfluorene		194,177		0.08	0.09	0.08	0.08	0.08	
Dibenzothiophene		184,152		0.09	0.08	0.08	0.08	0.08	
2/3-Methyldibenzothiophenes		198,197		0.72	0.72	0.72	0.71	0.71	
2,4-Dimethyldibenzothiophene		212,197		0.50	0.51	0.51	0.51	0.51	
3-Methylphenanthrene		192,191							
2-Methylphenanthrene		192,191		0.58	0.57	0.59	0.58	0.58	
2-Methylanthracene		192,191		0.51	0.50	0.51	0.50	0.50	
9/4-Methylphenanthrene		192,191							
1-Methylphenanthrene		192,191		0.60	0.61	0.61	0.60	0.60	
3,6-Dimethylphenanthrene		206,191		0.37	0.36	0.36	0.36	0.36	
2,6-Dimethylphenanthrene		206,191							
1,7-Dimethylphenanthrene		206,191		0.34	0.34	0.33	0.34	0.34	
1,8-Dimethylphenanthrene		206,191							

COMPOUND	LAB FLAG [1]	M/Z's FORMING RATIO	ION ABUNDANCE RATIO CS0	CS1	CS2	CS3	CS4	CS5	CS6
1,2,6-Trimethylphenanthrene		220,205		0.61	0.59	0.60	0.59	0.59	
Retene		234,219		1.65	1.68	1.65	1.67	1.65	
3-Methylfluoranthene/Benzo[a] fluorene		216,215		1.10	1.09	1.08	1.07	1.06	
5/6-Methylchrysene		242							
1-Methylchrysene		242							
5,9-Dimethylchrysene		256							
7-Methylbenzo[a]pyrene		266							
1,4,6,7-Tetramethylnaphthalene		184,139		0.03	0.03	0.03	0.03	0.03	

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: [redacted]

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s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

Form 3D

POLYAROMATIC HYDROCARBON INITIAL CALIBRATION ION ABUNDANCE RATIOS

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	**CS0 Data Filename:**	N/A
		CS1 Data Filename:	PH8S4734.D
Instrument ID:	LR GC/MS	**CS2 Data Filename:**	PH8S4735.D
GC Column ID:	RTX5	**CS3 Data Filename:**	PH8S4736.D
		CS4 Data Filename:	PH8S4738.D
		CS5 Data Filename:	PH8S4737.D
		CS6 Data Filename:	N/A

LABELED COMPOUND	LAB FLAG[1]	M/Z's FORMING RATIO	ION ABUNDANCE RATIO CS0	CS1	CS2	CS3	CS4	CS5	CS6
Naphthalene d-8		136,134		0.09	0.09	0.09	0.09	0.09	
2-Methylnaphthalene d-10		152,151		0.19	0.19	0.19	0.19	0.19	
Biphenyl d-10		164							
2,6-Dimethylnaphthalene d-12		168,150		0.75	0.74	0.75	0.75	0.75	
Acenaphthylene d-8		160,158		0.15	0.15	0.15	0.15	0.15	
Dibenzothiophene d-8		192,160		0.08	0.08	0.09	0.09	0.09	
Phenanthrene d-10		188,184		0.14	0.14	0.14	0.14	0.14	
Fluoranthene d-10		212,208		0.16	0.16	0.16	0.16	0.16	
Benzo[a]anthracene d-12		240,236		0.23	0.23	0.23	0.23	0.23	
Chrysene d-12		240,236		0.26	0.26	0.26	0.26	0.26	
Benzo[b]fluoranthene d-12		264,260		0.20	0.20	0.21	0.21	0.20	
Benzo[k]fluoranthene d-12		264,260		0.20	0.20	0.20	0.20	0.20	
Benzo[a]pyrene d-12		264,260		0.20	0.20	0.20	0.20	0.20	
Perylene d-12		264,260		0.24	0.24	0.24	0.24	0.24	
Dibenzo[a,h]anthracene d-14		292,288		0.23	0.24	0.24	0.24	0.24	
Indeno[1,2,3-cd]pyrene d-12		288,284		0.18	0.18	0.18	0.18	0.18	
Benzo[ghi]perylene d-12		288,284		0.19	0.19	0.19	0.19	0.19	

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ___________[redacted]__________

For Axys Internal Use Only [XSL Template: Form3D.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: GENERIC-SPECS_PAH_LO_28-Sep-2018_PH8S__Form3D_GS77951.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

Form 4A

POLYAROMATIC HYDROCARBON CALIBRATION VERIFICATION

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	**VER Data Filename:**	PH8S4771.D
Instrument ID:	LR GC/MS	**Analysis Date:**	01-Oct-2018
GC Column ID:	RTX5	**Analysis Time:**	20:16:00

COMPOUND	CAS NO.	LAB FLAG [1]	m/e ION CHANNELS	ION ABUND. RATIO	SAMPLE QC LIMITS	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL)
Naphthalene	91-20-3		128,102	0.07	0.06-0.08	1940	1480-2470
Acenaphthylene	208-96-8		152,151	0.20	0.16-0.24	1950	1480-2460
Acenaphthene	83-32-9		154,153	1.15	0.92-1.38	2000	1500-2510
2-Methylfluorene	1430-97-3		180,165	1.27	1.02-1.52	1990	1500-2500
Fluorene	86-73-7		166,165	0.99	0.79-1.19	1910	1470-2460
Phenanthrene	85-01-8		178,176	0.19	0.15-0.23	1970	1510-2520
Anthracene	120-12-7		178,176	0.19	0.15-0.23	1920	1500-2510
Fluoranthene	206-44-0		202,200	0.20	0.16-0.24	1910	1480-2470
Pyrene	129-00-0		202,200	0.21	0.17-0.25	1920	1490-2480
Benz[a]anthracene	56-55-3		228,226	0.27	0.22-0.32	1990	1510-2520
Chrysene	218-01-9		228,226	0.30	0.24-0.36	1960	1510-2510
Benzo[b]fluoranthene	205-99-2		252,253	0.22	0.18-0.26	1930	1510-2520
Benzo[j,k]fluoranthenes			252,253	0.22	0.18-0.26	1980	1510-2520
Benzo[e]pyrene	192-97-2		252,253	0.22	0.18-0.26	1960	1500-2500
Benzo[a]pyrene	50-32-8		252,253	0.21	0.17-0.25	2000	1500-2500
Perylene	198-55-0		252,253	0.21	0.17-0.25	2030	1500-2500
Dibenz[a,h]anthracene	53-70-3		278,139	0.16	0.10-0.22	1930	1480-2470
Indeno[1,2,3-cd]pyrene	193-39-5		276,138	0.20	0.13-0.27	1980	1510-2520
Benzo[ghi]perylene	191-24-2		276,138	0.22	0.14-0.30	1940	1480-2460
2-Methylnaphthalene	91-57-6		142,141	0.89	0.71-1.07	1970	1500-2500
1-Methylnaphthalene	90-12-0		142,141	0.92	0.74-1.10	1990	1500-2500
Biphenyl	92-52-4		154,152	0.29	0.23-0.35	1980	1510-2510
1,2-Dimethylnaphthalene	573-98-8		156,141	1.27	1.02-1.52	1960	1500-2500
2,6-Dimethylnaphthalene	581-42-0		156,141	0.69	0.55-0.83	1970	1500-2500
2,3,6-Trimethylnaphthalene	829-26-5		170,155	0.90	0.72-1.08	2000	1500-2500
2,3,5-Trimethylnaphthalene	2245-38-7		170,155	0.90	0.72-1.08	1990	1500-2500
1,7-Dimethylfluorene	442-66-0		194,177	0.08	0.06-0.10	2000	1500-2500
Dibenzothiophene	132-65-0		184,152	0.08	0.06-0.10	1960	1500-2500
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3		198,197	0.71	0.57-0.85	2020	1500-2500
2,4-Dimethyldibenzothiophene	31317-18-7		212,197	0.50	0.40-0.60	2140	1500-2500
2-Methylphenanthrene	2531-84-2		192,191	0.58	0.46-0.70	2020	1500-2500
2-Methylanthracene	613-12-7		192,191	0.51	0.41-0.61	1970	1500-2500
1-Methylphenanthrene	832-69-9		192,191	0.60	0.48-0.72	2050	1500-2500
3,6-Dimethylphenanthrene	1576-67-6		206,191	0.35	0.28-0.42	1960	1500-2500
1,7-Dimethylphenanthrene	483-87-4		206,191	0.33	0.26-0.40	1980	1510-2510
1,2,6-Trimethylphenanthrene	30436-55-6		220,205	0.60	0.48-0.72	2370	1750-2920
Retene	483-65-8		234,219	1.64	1.31-1.97	2030	1500-2500
3-Methylfluoranthene/Benzo[a]fluorene	1706-01-0/238-84-6		216,215	1.08	0.86-1.30	2040	1500-2500
5/6-Methylchrysene	3697-24-3/1705-85-7		242	0	N/A	1970	1500-2500
1-Methylchrysene	3351-28-8		242	0	N/A	2040	1500-2500
5,9-Dimethylchrysene	139493-40-6		256	0	N/A	2080	1500-2500
7-Methylbenzo[a]pyrene	63041-77-0		266	0	N/A	2070	1500-2500
1,4,6,7-Tetramethylnaphthalene	13764-18-6		184,139	0.03	0.02-0.04	2010	1500-2500

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: [redacted]

For Axys Internal Use Only [XSL Template: Pest4A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: GENERIC-SPECS_PAH_LO_PH8S4771.D__Form4A_SJ2440260.html; Workgroup: WG65361; Design ID: 526]

s.19(1)

SGS AXYS METHOD MLA-021 Rev 12

Form 4B
POLYAROMATIC HYDROCARBON CALIBRATION VERIFICATION

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	**VER Data Filename:**	PH8S4771.D
Instrument ID:	LR GC/MS	**Analysis Date:**	01-Oct-2018
GC Column ID:	RTX5	**Analysis Time:**	20:16:00

LABELED COMPOUND	CAS NO.	LAB FLAG [1]	m/e ION CHANNELS	ION ABUND. RATIO	SAMPLE QC LIMITS	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL)
Naphthalene d-8	1146-65-2		136,134	0.09	0.07-0.11	1970	1500-2500
2-Methylnaphthalene d-10	7297-45-2		152,151	0.19	0.15-0.23	1940	1480-2460
Biphenyl d-10	1486-01-7		164	0	N/A	2010	1530-2560
2,6-Dimethylnaphthalene d-12	350820-12-1		168,150	0.74	0.59-0.89	2040	1540-2570
Acenaphthylene d-8	93951-97-4		160,158	0.15	0.12-0.18	2010	1550-2580
Dibenzothiophene d-8	33262-29-2		192,160	0.09	0.07-0.11	1880	1530-2540
Phenanthrene d-10	1517-22-2		188,184	0.14	0.11-0.17	1700	1350-2260
Fluoranthene d-10	93951-69-0		212,208	0.16	0.13-0.19	1980	1490-2480
Benzo[a]anthracene d-12	1718-53-2		240,236	0.23	0.18-0.28	2110	1520-2540
Chrysene d-12	1719-03-5		240,236	0.26	0.21-0.31	2060	1470-2450
Benzo[b]fluoranthene d-12	93951-98-5		264,260	0.21	0.17-0.25	1940	1480-2460
Benzo[k]fluoranthene d-12	93952-01-3		264,260	0.20	0.16-0.24	2000	1500-2500
Benzo[a]pyrene d-12	63466-71-7		264,260	0.20	0.16-0.24	2070	1550-2590
Perylene d-12	1520-96-3		264,260	0.24	0.19-0.29	2140	1610-2690
Dibenzo[a,h]anthracene d-14	13250-98-1		292,288	0.25	0.16-0.34	2170	1440-2390
Indeno[1,2,3-cd]pyrene d-12	203578-33-0		288,284	0.18	0.12-0.24	2140	1490-2490
Benzo[ghi]perylene d-12	93951-66-7		288,284	0.19	0.12-0.26	2120	1490-2480

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ___________[redacted]__________

For Axys Internal Use Only [XSL Template: Pest4B.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50; Report Filename: GENERIC-SPECS_PAH_LO_PH8S4771.D__Form4B_SJ2440260.html; Workgroup: WG65361; Design ID: 526]

s.19(1) SGS AXYS METHOD MLA-021 Rev 12

Form 4A

POLYAROMATIC HYDROCARBON CALIBRATION VERIFICATION

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	**VER Data Filename:**	PH8S4816.D
Instrument ID:	LR GC/MS	**Analysis Date:**	03-Oct-2018
GC Column ID:	RTX5	**Analysis Time:**	07:31:00

COMPOUND	CAS NO.	LAB FLAG [1]	m/e ION CHANNELS	ION ABUND. RATIO	SAMPLE QC LIMITS	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL)
Naphthalene	91-20-3		128,102	0.07	0.06-0.08	2030	1480-2470
Acenaphthylene	208-96-8		152,151	0.21	0.17-0.25	2090	1480-2460
Acenaphthene	83-32-9		154,153	1.15	0.92-1.38	2020	1500-2510
2-Methylfluorene	1430-97-3		180,165	1.28	1.02-1.54	2030	1500-2500
Fluorene	86-73-7		166,165	0.99	0.79-1.19	1940	1470-2460
Phenanthrene	85-01-8		178,176	0.19	0.15-0.23	2020	1510-2520
Anthracene	120-12-7		178,176	0.19	0.15-0.23	1970	1500-2510
Fluoranthene	206-44-0		202,200	0.20	0.16-0.24	1950	1480-2470
Pyrene	129-00-0		202,200	0.21	0.17-0.25	1940	1490-2480
Benz[a]anthracene	56-55-3		228,226	0.27	0.22-0.32	2000	1510-2520
Chrysene	218-01-9		228,226	0.30	0.24-0.36	1980	1510-2510
Benzo[b]fluoranthene	205-99-2		252,253	0.22	0.18-0.26	1940	1510-2520
Benzo[j,k]fluoranthenes			252,253	0.22	0.18-0.26	2030	1510-2520
Benzo[e]pyrene	192-97-2		252,253	0.22	0.18-0.26	1960	1500-2500
Benzo[a]pyrene	50-32-8		252,253	0.22	0.18-0.26	2020	1500-2500
Perylene	198-55-0		252,253	0.22	0.18-0.26	2030	1500-2500
Dibenz[a,h]anthracene	53-70-3		278,139	0.16	0.10-0.22	1980	1480-2470
Indeno[1,2,3-cd]pyrene	193-39-5		276,138	0.20	0.13-0.27	2000	1510-2520
Benzo[ghi]perylene	191-24-2		276,138	0.21	0.14-0.28	2020	1480-2460
2-Methylnaphthalene	91-57-6		142,141	0.90	0.72-1.08	2020	1500-2500
1-Methylnaphthalene	90-12-0		142,141	0.92	0.74-1.10	2050	1500-2500
Biphenyl	92-52-4		154,152	0.29	0.23-0.35	1990	1510-2510
1,2-Dimethylnaphthalene	573-98-8		156,141	1.29	1.03-1.55	1990	1500-2500
2,6-Dimethylnaphthalene	581-42-0		156,141	0.69	0.55-0.83	1980	1500-2500
2,3,6-Trimethylnaphthalene	829-26-5		170,155	0.90	0.72-1.08	2030	1500-2500
2,3,5-Trimethylnaphthalene	2245-38-7		170,155	0.91	0.73-1.09	2020	1500-2500
1,7-Dimethylfluorene	442-66-0		194,177	0.08	0.06-0.10	2130	1500-2500
Dibenzothiophene	132-65-0		184,152	0.08	0.06-0.10	1980	1500-2500
2/3-Methyldibenzothiophenes	20928-02-3/16587-52-3		198,197	0.71	0.57-0.85	2050	1500-2500
2,4-Dimethyldibenzothiophene	31317-18-7		212,197	0.51	0.41-0.61	2150	1500-2500
2-Methylphenanthrene	2531-84-2		192,191	0.58	0.46-0.70	2030	1500-2500
2-Methylanthracene	613-12-7		192,191	0.50	0.40-0.60	1980	1500-2500
1-Methylphenanthrene	832-69-9		192,191	0.60	0.48-0.72	2100	1500-2500
3,6-Dimethylphenanthrene	1576-67-6		206,191	0.36	0.29-0.43	1940	1500-2500
1,7-Dimethylphenanthrene	483-87-4		206,191	0.34	0.27-0.41	1960	1510-2510
1,2,6-Trimethylphenanthrene	30436-55-6		220,205	0.59	0.47-0.71	2400	1750-2920
Retene	483-65-8		234,219	1.63	1.30-1.96	2020	1500-2500
3-Methylfluoranthene/Benzo[a] fluorene	1706-01-0/238-84-6		216,215	1.08	0.86-1.30	2020	1500-2500
5/6-Methylchrysene	3697-24-3/1705-85-7		242	0	N/A	1930	1500-2500
1-Methylchrysene	3351-28-8		242	0	N/A	2000	1500-2500
5,9-Dimethylchrysene	139493-40-6		256	0	N/A	2020	1500-2500
7-Methylbenzo[a]pyrene	63041-77-0		266	0	N/A	2070	1500-2500
1,4,6,7-Tetramethylnaphthalene	13764-18-6		184,139	0.03	0.02-0.04	2040	1500-2500

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ________[redacted]________

For Axys Internal Use Only [XSL Template: Pest4A.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50;
Report Filename: GENERIC-SPECS_PAH_LO_PH8S4816.D__Form4A_SJ2441308.html; Workgroup: WG65361; Design ID: 526]

SGS AXYS METHOD MLA-021 Rev 12

Form 4B
POLYAROMATIC HYDROCARBON CALIBRATION VERIFICATION

SGS AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	28-Sep-2018	**VER Data Filename:**	PH8S4816.D
Instrument ID:	LR GC/MS	**Analysis Date:**	03-Oct-2018
GC Column ID:	RTX5	**Analysis Time:**	07:31:00

LABELED COMPOUND	CAS NO.	LAB FLAG [1]	m/e ION CHANNELS	ION ABUND. RATIO	SAMPLE QC LIMITS	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL)
Naphthalene d-8	1146-65-2		136,134	0.09	0.07-0.11	1960	1500-2500
2-Methylnaphthalene d-10	7297-45-2		152,151	0.19	0.15-0.23	1930	1480-2460
Biphenyl d-10	1486-01-7		164	0	N/A	2030	1530-2560
2,6-Dimethylnaphthalene d-12	350820-12-1		168,150	0.75	0.60-0.90	2050	1540-2570
Acenaphthylene d-8	93951-97-4		160,158	0.15	0.12-0.18	2050	1550-2580
Dibenzothiophene d-8	33262-29-2		192,160	0.09	0.07-0.11	1890	1530-2540
Phenanthrene d-10	1517-22-2		188,184	0.15	0.12-0.18	1690	1350-2260
Fluoranthene d-10	93951-69-0		212,208	0.17	0.14-0.20	2010	1490-2480
Benzo[a]anthracene d-12	1718-53-2		240,236	0.23	0.18-0.28	2070	1520-2540
Chrysene d-12	1719-03-5		240,236	0.26	0.21-0.31	2040	1470-2450
Benzo[b]fluoranthene d-12	93951-98-5		264,260	0.21	0.17-0.25	1950	1480-2460
Benzo[k]fluoranthene d-12	93952-01-3		264,260	0.20	0.16-0.24	2020	1500-2500
Benzo[a]pyrene d-12	63466-71-7		264,260	0.20	0.16-0.24	2090	1550-2590
Perylene d-12	1520-96-3		264,260	0.24	0.19-0.29	2150	1610-2690
Dibenzo[a,h]anthracene d-14	13250-98-1		292,288	0.26	0.17-0.35	2170	1440-2390
Indeno[1,2,3-cd]pyrene d-12	203578-33-0		288,284	0.18	0.12-0.24	2130	1490-2490
Benzo[ghi]perylene d-12	93951-66-7		288,284	0.19	0.12-0.26	2080	1490-2480

(1) Where applicable, custom lab flags have been used on this report.

These data are validated and reported as accurate and in accord with SGS AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ___________[redacted]__________

For Axys Internal Use Only [XSL Template: Pest4B.xsl; Created: 09-Oct-2018 09:39:36; Application: XMLTransformer-1.16.50; Report Filename: GENERIC-SPECS_PAH_LO_PH8S4816.D__Form4B_SJ2441308.html; Workgroup: WG65361; Design ID: 526]

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
BFR	BTBPE	SGS AXYS MLA-033	MLA-033		Y											Y							Y											
	DBDPE	SGS AXYS MLA-033	MLA-033		Y											Y							Y											
	HBB	SGS AXYS MLA-033	MLA-033		Y											Y							Y											
	PBEB	SGS AXYS MLA-033	MLA-033		Y											Y							Y											
Bisphenols	Bisphenol A	SGS AXYS MLA-113	MLA-113		Y																		Y											
	Bisphenol AF	SGS AXYS MLA-113	MLA-113		Y																		Y											
	Bisphenol B	SGS AXYS MLA-113	MLA-113		Y																		Y											
	Bisphenol E	SGS AXYS MLA-113	MLA-113		Y																		Y											
	Bisphenol F	SGS AXYS MLA-113	MLA-113		Y																		Y											
	Bisphenol S	SGS AXYS MLA-113	MLA-113		Y																		Y											
BPA and MPE	4,4'-dihydroxy-2,2-diphenylpropane (Bisphenol A) (BPA)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-(3-carboxypropyl) phthalate (MCPP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-2-ethylhexyl phthalate (MEHP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-benzyl phthalate (MBzP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-butyl phthalate (MBP) (n + iso)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-cyclohexyl phthalate (MCHP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-ethyl phthalate (MEP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-iso-nonyl phthalate (MiNP)	SGS AXYS MLA-059	MLA-059																			Y												
	Mono-methyl phthalate (MMP)	SGS AXYS MLA-059	MLA-059																			Y												
HBCDD	alpha-hexabromocyclododecane (a-HBCDD)	SGS AXYS MLA-070	MLA-070	Y																														
	beta-hexabromocyclododecane (b-HBCDD)	SGS AXYS MLA-070	MLA-070	Y																														
	gamma-hexabromocyclododecane (g-HBCDD)	SGS AXYS MLA-070	MLA-070	Y																														
OC Pesticides	"Organochlorine Pesticides" category (CA only)	EPA 608	MLA-007																					Y										
		EPA 625	MLA-007																					Y										
		EPA 8081	MLA-007			Y																												
	"Pesticides" category (CA only)	EPA 8270	MLA-007			Y																												
	2,4'-DDD	EPA 625	MLA-007																						Y								Y	
		EPA 8270	MLA-007				Y					Y		Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	2,4'-DDE	EPA 625	MLA-007																						Y								Y	
		EPA 8270	MLA-007				Y					Y		Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	2,4'-DDT	EPA 625	MLA-007																						Y								Y	
		EPA 8270	MLA-007				Y					Y		Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	4,4'-DDD	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	4,4'-DDE	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum: CALA	Solids: CALA	Solids: California DPH	Solids: Florida DOH	Solids: Minnesota DOH	Solids: New Jersey DEP	Solids: New York DOH	Solids: Virginia DGS	Solids: Washington DE	Solids: Maine DOH	Solids: ANAB ISO 17025	Solids: ANAB DoD **	Tissue: CALA	Tissue: Florida DOH	Tissue: Minnesota DOH	Tissue: New Jersey DEP	Tissue: Virginia DGS	Tissue: ANAB ISO 17025	Urine: CALA	Water: CALA	Water, Non-Potable: California DPH	Water, Non-Potable: Florida DOH	Water, Non-Potable: Minnesota DOH	Water, Non-Potable: New Jersey DEP	Water, Non-Potable: New York DOH	Water, Non-Potable: Virginia DGS	Water, Non-Potable: Washington DE *	Water, Non-Potable: Maine DOH	Water, Non-Potable: Pennsylvania DEP	Water, Non-Potable: ANAB ISO 17025	Water, Non-Potable: ANAB DoD **
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	4,4'-DDT	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Aldrin	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Alpha-HCH	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Beta-HCH	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Chlordane, technical	EPA 625	MLA-007																												Y			
		EPA 8270	MLA-007				Y			Y	Y		Y	Y											Y			Y	Y		Y		Y	
		SGS AXYS MLA-007	MLA-007				Y							Y											Y								Y	
	cis-Chlordane (alpha-Chlordane)	EPA 8270	MLA-007				Y			Y		Y	Y	Y											Y			Y			Y		Y	
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	cis Nonachlor	EPA 8270	MLA-007				Y					Y		Y											Y								Y	
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Delta-HCH	EPA 608	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Dieldrin	EPA 608	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Endosulphan I	EPA 608	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA 028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Endosulphan II	EPA 608	MLA-007																						Y			Y	Y		Y		Y	

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Endosulphan sulphate	EPA 608	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Endrin	EPA 608	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Endrin aldehyde	EPA 608	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y									Y		Y								Y	
	Endrin ketone	EPA 8081	MLA-007				Y			Y		Y		Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y									
	Gamma-HCH (Lindane)	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Heptachlor	EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Heptachlor epoxide	EPA 608	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Hexachlorobenzene	EPA 1625	MLA-007																						Y			Y					Y	
		EPA 8270	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Methoxychlor	EPA 608	MLA-007																						Y			Y	Y				Y	
		EPA 8081	MLA-007				Y			Y	Y	Y	Y	Y																				
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Mirex	EPA 8270	MLA-007				Y			Y		Y		Y											Y			Y	Y		Y		Y	
		EPA 1699	MLA-028				Y							Y											Y								Y	

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	Oxychlordane	EPA 8270	MLA-007				Y					Y													Y								Y	
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y									Y							Y		Y								Y	
	Toxaphene	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	trans-Chlordane (gamma-Chlordane)	EPA 8270	MLA-007				Y			Y		Y	Y	Y											Y			Y			Y		Y	
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y							Y		Y								Y	
	trans-Nonachlor	EPA 8270	MLA-007				Y					Y		Y											Y								Y	
		EPA 1699	MLA-028				Y							Y											Y								Y	
		SGS AXYS MLA-028	MLA-028	Y	Y		Y					Y		Y		Y							Y		Y					Y			Y	
		SGS AXYS MLA-007	MLA-007	Y	Y		Y							Y		Y									Y								Y	
PAH	1,2,6-Trimethylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1,2-Dimethylnaphthalene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1,4,6,7-Tetramethylnaphthalene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1,7-Dimethylfluorene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1,7-Dimethylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1,8-Dimethylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1-Methylchrysene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1-Methylnaphthalene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	1-Methylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2,3,5-Trimethylnaphthalene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2,3,6-Trimethylnaphthalene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2,4-Dimethyldibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2,6-Dimethylnaphthalene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2,6-Dimethylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2-Methylanthracene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2-Methyldibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2-Methylfluorene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	2-Methylnaphthalene	EPA 1625	MLA-021																														Y	
		EPA 8270	MLA-021				Y			Y				Y											Y									
		SGS AXYS MLA-021	MLA-021		Y		Y							Y									Y										Y	
	2-Methylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	3,6-Dimethylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	3-Methyldibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	3-Methylfluoranthene/ Benzo(a)fluorene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	3-Methylphenanthrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	5,9-Dimethylchrysene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	5/6-Methylchrysenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	7-Methylbenzo(a)pyrene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	9/4-Methylphenanthrenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	Acenaphthene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Acenaphthylene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Anthracene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Benz[a]anthracene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Benzo[a]pyrene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Benzo[b]fluoranthene	EPA 1625	MLA-021																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Benzo[e]pyrene	SGS AXYS MLA-021	MLA-021		Y											Y							Y											
	Benzo[ghi]perylene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Benzo[j/k]fluoranthenes	SGS AXYS MLA-021	MLA-021		Y											Y							Y											
	Benzo[k]fluoranthene	EPA 1625	MLA-021																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-021				Y			Y			Y	Y																				
		SGS AXYS MLA-021	MLA-021				Y							Y											Y								Y	
	Biphenyl	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Acenaphthenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Benz(a)anthracenes/chrysenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Benzofluoranthenes/ Benzopyrenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Biphenyls	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Dibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Fluoranthenes/Pyrenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Fluorenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Naphthalenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C1-Phenanthrenes/Anthracenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Benz(a)anthracenes/Chrysenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Benzofluoranthenes/ Benzopyrenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Biphenyls	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Dibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Fluoranthenes/Pyrenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Fluorenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Naphthalenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C2-Phenanthrenes/Anthracenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C3-Benz(a)anthracenes/Chrysenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C3-Dibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C3-Fluoranthenes/Pyrenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C3-Fluorenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C3-Naphthalenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C3-Phenanthrenes/Anthracenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C4-Benz(a)anthracenes/Chrysenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C4-Dibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C4-Fluoranthenes/Pyrenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C4-Naphthalenes	SGS AXYS MLA-021	MLA-021		Y																		Y											
	C4-Phenanthrenes/Anthracenes	SGS AXYS MLA-021	MLA-021		Y																		Y											

Accreditation Scope

SGS AXYS Analytical Services Ltd.
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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	Chrysene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Dibenz[a,h]anthracene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Dibenzothiophene	SGS AXYS MLA-021	MLA-021		Y																		Y											
	Fluoranthene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Fluorene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Indeno[1,2,3-cd]pyrene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Naphthalene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Perylene	SGS AXYS MLA-021	MLA-021		Y											Y							Y											
	Phenanthrene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Pyrene	EPA 1625	MLA-021																						Y			Y	Y				Y	
		EPA 8270	MLA-021				Y			Y	Y		Y	Y																				
		SGS AXYS MLA-021	MLA-021		Y		Y							Y		Y							Y		Y								Y	
	Retene	SGS AXYS MLA-021	MLA-021		Y																		Y											
PBDE	BDE 10 2,6-dibromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 100 2,2',4,4',6-pentabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 105 2,3,3',4,4'-pentabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 11 3,3'-dibromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 116 2,3,4,5,6-pentabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 119 2,3',4,4',6-pentabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 12 3,4-dibromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 126 3,3',4,4',5-pentabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 13 3,4'-dibromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 140 2,2',3,4,4',6'-hexabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 15 4,4'-dibromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 153 2,2',4,4',5,5'-hexabromodiphenylether	EPA 1614	MLA-033									Y																		Y				

Accreditation Scope

SGS AXYS Analytical Services Ltd.
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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 154 2,2',4,4',5',6-hexabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 155 2,2',4,4',6,6'-hexabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 166 2,3,4,4',5,6-hexabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 17 2,2',4-tribromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 181 2,2',3,4,4',5,6-heptabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 190 2,3,3',4,4',5,6-heptabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 206 2,2',3,3',4,4',5,5',6-nonabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 207 2,2',3,3',4,4',5,6,6'-nonabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 208 2,2',3,3',4,5,5',6,6'-nonabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 209 Decabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 25 2,3',4-tribromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 28 2,4,4'-tribromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 30 2,4,6-tribromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 35 3,3',4-tribromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 37 3,4,4'-tribromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 47 2,2',4,4'-tetrabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 49 2,2',4,5'-tetrabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 66 2,3',4,4'-tetrabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 7 2,4-dibromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 75 2,4,4',6-tetrabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 77 3,3',4,4'-tetrabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 8 2,4'-dibromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 85 2,2',3,4,4'-pentabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE 99 2,2',4,4',5-pentabromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE-183 2,2',3,4,4',5',6-heptabromodiphenylether	EPA 1614	MLA-033									Y																		Y				

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SGS AXYS Analytical Services Ltd.
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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
	BDE-33 2',3,4-tribromodiphenylether	EPA 1614	MLA-033									Y																		Y				
		SGS AXYS MLA-033	MLA-033	Y	Y											Y							Y											
PCB Aroclors	"PCBs" category (CA only)	EPA 625	MLA-007																					Y										
		EPA 8270	MLA-007			Y																												
	PCB Aroclor 1016	EPA 1668	MLA-010				Y						Y	Y											Y						Y		Y	
		EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y			Y																				
		SGS AXYS MLA-010	MLA-010				Y							Y											Y								Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y		Y							Y		Y								Y	
	PCB Aroclor 1016/1242	EPA 8270	MLA-007									Y																						
	PCB Aroclor 1221	EPA 1668	MLA-010				Y						Y	Y											Y						Y		Y	
		EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y		Y																				
		SGS AXYS MLA-010	MLA-010				Y							Y											Y								Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y		Y							Y		Y								Y	
	PCB Aroclor 1232	EPA 1668	MLA-010				Y						Y	Y											Y						Y		Y	
		EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y		Y																				
		SGS AXYS MLA-010	MLA-010				Y							Y											Y								Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y		Y							Y		Y								Y	
	PCB Aroclor 1242	EPA 1668	MLA-010				Y						Y	Y											Y						Y		Y	
		EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y			Y																				
		SGS AXYS MLA-010	MLA-010				Y							Y											Y								Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y		Y							Y		Y								Y	
	PCB Aroclor 1248	EPA 1668	MLA-010				Y						Y	Y											Y						Y		Y	
		EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y		Y																				
		SGS AXYS MLA-010	MLA-010				Y							Y											Y								Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y		Y							Y		Y								Y	
	PCB Aroclor 1254	EPA 1668	MLA-010				Y						Y	Y											Y						Y		Y	
		EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y		Y																				
		SGS AXYS MLA-010	MLA-010				Y							Y											Y								Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y		Y							Y		Y								Y	
	PCB Aroclor 1260	EPA 1668	MLA-010				Y						Y	Y											Y						Y		Y	
		EPA 625	MLA-007																						Y			Y	Y		Y		Y	
		EPA 8270	MLA-007				Y			Y	Y	Y		Y																				
		SGS AXYS MLA-010	MLA-010				Y							Y											Y								Y	
		SGS AXYS MLA-007	MLA-007		Y		Y							Y		Y							Y		Y								Y	
	PCB Aroclor 1268	SGS AXYS MLA-007	MLA-007		Y											Y							Y											
PCB congeners	PCB 1 2-Chlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 10 2,6-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 100 2,2',4,4',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	

Accreditation Scope

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	PCB 101 2,2',4,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 101/90/89	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 102 2,2',4,5,6'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 103 2,2',4,5',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 104 2,2',4,6,6'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 105 2,3,3',4,4'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 105/127	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 106 2,3,3',4,5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 107 2,3,3',4',5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 107/109	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 108 2,3,3',4,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 109 2,3,3',4,6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 11 3,3'-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 110 2,3,3',4',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		FPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 111 2,3,3',5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 111/117	EPA 8270	MLA-007									Y																						
	PCB 112 2,3,3',5,6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 113 2,3,3',5',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 114 2,3,4,4',5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 115 2,3,4,4',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 116 2,3,4,5,6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 117 2,3,4',5,6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	

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SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 118 2,3',4,4',5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 118/106	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 119 2,3',4,4',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 12 3,4-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 12/13	EPA 8270	MLA-007									Y																						
	PCB 120 2,3',4,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 121 2,3',4,5',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 122 2,3,3',4',5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 123 2,3',4,4',5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 124 2,3',4',5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 125 2,3',4',5',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 126 3,3',4,4',5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 127 3,3',4,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 128 2,2',3,3',4,4'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 129 2,2',3,3',4,5-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 13 3,4'-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 130 2,2',3,3',4,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 131 2,2',3,3',4,6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	

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Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum: CALA	Solids: CALA	Solids: California DPH	Solids: Florida DOH	Solids: Minnesota DOH	Solids: New Jersey DEP	Solids: New York DOH	Solids: Virginia DGS	Solids: Washington DE	Solids: Maine DOH	Solids: ANAB ISO 17025	Solids: ANAB DoD **	Tissue: CALA	Tissue: Florida DOH	Tissue: Minnesota DOH	Tissue: New Jersey DEP	Tissue: Virginia DGS	Tissue: ANAB ISO 17025	Urine: CALA	Water: CALA	Water, Non-Potable: California DPH	Water, Non-Potable: Florida DOH	Water, Non-Potable: Minnesota DOH	Water, Non-Potable: New Jersey DEP	Water, Non-Potable: New York DOH	Water, Non-Potable: Virginia DGS	Water, Non-Potable: Washington DE *	Water, Non-Potable: Maine DOH	Water, Non-Potable: Pennsylvania DEP	Water, Non-Potable: ANAB ISO 17025	Water, Non-Potable: ANAB DoD **
	PCB 131/142	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 132 2,2',3,3',4,6'-Hexachlorob phenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 132/168	EPA 8270	MLA-007									Y																						
	PCB 133 2,2',3,3',5,5'-Hexachlorob phenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 134 2,2',3,3',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 134/143	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 135 2,2',3,3',5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 136 2,2',3,3',6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 137 2,2',3,4,4',5-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 138 2,2',3,4,4',5'-Hexachlorob phenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 138/163/164	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 139 2,2',3,4,4',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 14 3,5-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 140 2,2',3,4,4',6'-Hexachlorob phenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 141 2,2',3,4,5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 142 2,2',3,4,5,6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 143 2,2',3,4,5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 144 2,2',3,4,5',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 144/135	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 145 2,2',3,4,6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 146 2,2',3,4',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 147 2,2',3,4',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 148 2,2',3,4',5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 149 2,2',3,4',5',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 149/139	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 15 4,4'-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 150 2,2',3,4',6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 151 2,2',3,5,5',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 152 2,2',3,5,6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 153 2,2',4,4',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 154 2,2',4,4',5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 155 2,2',4,4',6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 156 2,3,3',4,4',5-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 157 2,3,3',4,4',5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 158 2,3,3',4,4',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	

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Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum: CALA	Solids: CALA	Solids: California DPH	Solids: Florida DOH	Solids: Minnesota DOH	Solids: New Jersey DEP	Solids: New York DOH	Solids: Virginia DGS	Solids: Washington DE	Solids: Maine DOH	Solids: ANAB ISO 17025	Solids: ANAB DoD **	Tissue: CALA	Tissue: Florida DOH	Tissue: Minnesota DOH	Tissue: New Jersey DEP	Tissue: Virginia DGS	Tissue: ANAB ISO 17025	Urine: CALA	Water: CALA	Water, Non-Potable: California DPH	Water, Non-Potable: Florida DOH	Water, Non-Potable: Minnesota DOH	Water, Non-Potable: New Jersey DEP	Water, Non-Potable: New York DOH	Water, Non-Potable: Virginia DGS	Water, Non-Potable: Washington DE *	Water, Non-Potable: Maine DOH	Water, Non-Potable: Pennsylvania DEP	Water, Non-Potable: ANAB ISO 17025	Water, Non-Potable: ANAB DoD **
	PCB 158/160	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 159 2,3,3',4,5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 16 2,2',3-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 16/32	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 160 2,3,3',4,5,6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 161 2,3,3',4,5',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 162 2,3,3',4',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 163 2,3,3',4',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 164 2,3,3',4',5',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 165 2,3,3',5,5',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 166 2,3,4,4',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 167 2,3',4,4',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 168 2,3',4,4',5',6-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 169 3,3',4,4',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 17 2,2',4-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 170 2,2',3,3',4,4',5-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 170/190	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 171 2,2',3,3',4,4',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 172 2,2',3,3',4,5,5'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 172/192	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 173 2,2',3,3',4,5,6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 174 2,2',3,3',4,5,6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 174/181	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 175 2,2',3,3',4,5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 176 2,2',3,3',4,6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 177 2,2',3,3',4,5',6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 178 2,2',3,3',5,5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 179 2,2',3,3',5,6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 18 2,2',5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 180 2,2',3,4,4',5,5'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 181 2,2',3,4,4',5,6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 182 2,2',3,4,4',5,6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 183 2,2',3,4,4',5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum: CALA	Solids: CALA	Solids: California DPH	Solids: Florida DOH	Solids: Minnesota DOH	Solids: New Jersey DEP	Solids: New York DOH	Solids: Virginia DGS	Solids: Washington DE	Solids: Maine DOH	Solids: ANAB ISO 17025	Solids: ANAB DoD **	Tissue: CALA	Tissue: Florida DOH	Tissue: Minnesota DOH	Tissue: New Jersey DEP	Tissue: Virginia DGS	Tissue: ANAB ISO 17025	Urine: CALA	Water: CALA	Water, Non-Potable: California DPH	Water, Non-Potable: Florida DOH	Water, Non-Potable: Minnesota DOH	Water, Non-Potable: New Jersey DEP	Water, Non-Potable: New York DOH	Water, Non-Potable: Virginia DGS	Water, Non-Potable: Washington DE *	Water, Non-Potable: Maine DOH	Water, Non-Potable: Pennsylvania DEP	Water, Non-Potable: ANAB ISO 17025	Water, Non-Potable: ANAB DoD **
	PCB 184 2,2',3,4,4',6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 185 2,2',3,4,5,5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 186 2,2',3,4,5,6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 187 2,2',3,4',5,5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 187/182	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 188 2,2',3,4',5,6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 189 2,3,3',4,4',5,5'-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 19 2,2',6-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 190 2,3,3',4,4',5,6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 191 2,3,3',4,4',5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 192 2,3,3',4,5,5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 193 2,3,3',4',5,5',6-Heptachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 194 2,2',3,3',4,4',5,5'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 195 2,2',3,3',4,4',5,6-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 196 2,2',3,3',4,4',5,6'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 196/203	EPA 8270	MLA-007									Y																						

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 197 2,2',3,3',4,4',6,6'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 198 2,2',3,3',4,5,5',6-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 199 2,2',3,3',4,5,5',6'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 2 3-Chlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 20 2,3,3'-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 200 2,2',3,3',4,5,6,6'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 201 2,2',3,3',4,5',6,6'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 202 2,2',3,3',5,5',6,6'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 203 2,2',3,4,4',5,5',6-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 204 2,2',3,4,4',5,6,6'-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 205 2,3,3',4,4',5,5',6-Octachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 206 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 207 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 208 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 209 Decachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 21 2,3,4-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 22 2,3,4'-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 23 2,3,5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 23/34	EPA 8270	MLA-007									Y																						
	PCB 24 2,3,6-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 24/27	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 25 2,3',4-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 26 2,3',5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 27 2,3',6-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 28 2,4,4'-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 29 2,4,5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 3 4-Chlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 30 2,4,6-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 31 2,4',5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 32 2,4',6-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 33 2,3',4'-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 33/20/21	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 34 2,3',5'-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	PCB 35 3,3',4-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 36 3,3',5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 37 3,4,4'-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 38 3,4,5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 39 3,4',5-Trichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 4 2,2'-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 4/10	EPA 8270	MLA-007									Y																						
	PCB 40 2,2',3,3'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 41 2,2',3,4-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 41/71/64/68	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 42 2,2',3,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 42/59	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 43 2,2',3,5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 44 2,2',3,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 45 2,2',3,6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 46 2,2',3,6'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 47 2,2',4,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 47/48/75	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 48 2,2',4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	

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Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum CALA	Solids CALA	Solids California DPH	Solids Florida DOH	Solids Minnesota DOH	Solids New Jersey DEP	Solids New York DOH	Solids Virginia DGS	Solids Washington DE	Solids Maine DOH	Solids ANAB ISO 17025	Solids ANAB DoD **	Tissue CALA	Tissue Florida DOH	Tissue Minnesota DOH	Tissue New Jersey DEP	Tissue Virginia DGS	Tissue ANAB ISO 17025	Urine CALA	Water CALA	Water, Non-Potable California DPH	Water, Non-Potable Florida DOH	Water, Non-Potable Minnesota DOH	Water, Non-Potable New Jersey DEP	Water, Non-Potable New York DOH	Water, Non-Potable Virginia DGS	Water, Non-Potable Washington DE *	Water, Non-Potable Maine DOH	Water, Non-Potable Pennsylvania DEP	Water, Non-Potable ANAB ISO 17025	Water, Non-Potable ANAB DoD **
	PCB 49 2,2',4,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 49/43	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 5 2,3-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 50 2,2',4,6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 51 2,2',4,6'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 52 2,2',5,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 52/73	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 53 2,2',5,6'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 54 2,2',6,6'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 55 2,3,3',4-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 56 2,3,3',4'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 56/60	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 57 2,3,3',5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 58 2,3,3',5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 59 2,3,3',6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 6 2,3'-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 60 2,3,4,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 61 2,3,4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 62 2,3,4,6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 62/65	EPA 8270	MLA-007									Y																						
	PCB 63 2,3,4',5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						

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Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum: CALA	Solids: CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	Tissue: CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	Urine: CALA	Water: CALA	Water, Non-Potable: California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 64 2,3,4',6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 65 2,3,5,6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 66 2,3',4,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 66/80	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 67 2,3',4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 68 2,3',4,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 69 2,3',4,6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 7 2,4-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 7/9	EPA 8270	MLA-007									Y																						
	PCB 70 2,3',4',5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 70/76	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 71 2,3',4',6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 72 2,3',5,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 73 2,3',5',6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 74 2,4,4',5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB 74/61	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 75 2,4,4',6-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 76 2,3',4',5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 77 3,3',4,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 78 3,3',4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA 010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 79 3,3',4,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	

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Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum CALA	Solids CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	Tissue CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	Urine CALA	Water CALA	Water, Non-Potable California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	PCB 8 2,4'-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 8/5	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 80 3,3',5,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 81 3,4,4',5-Tetrachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 82 2,2',3,3',4-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 83 2,2',3,3',5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 83/108	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 84 2,2',3,3',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 85 2,2',3,4,4'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 85/120	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 86 2,2',3,4,5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 87 2,2',3,4,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 87/115/116	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 88 2,2',3,4,6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 88/121	EPA 8270	MLA-007									Y																						
	PCB 89 2,2',3,4,6'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 9 2,5-Dichlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y		Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 90 2,2',3,4',5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 91 2,2',3,4',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 92 2,2',3,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 93 2,2',3,5,6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 94 2,2',3,5,6'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 95 2,2',3,5',6-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 95/93	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 96 2,2',3,6,6'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 97 2,2',3,4',5'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 97/86	EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	PCB 98 2,2',3,4',6'-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
	PCB 98/102	EPA 8270	MLA-007									Y																						
	PCB 99 2,2',4,4',5-Pentachlorobiphenyl	EPA 1668	MLA-010				Y		Y	Y	Y	Y	Y	Y							Y				Y		Y	Y	Y	Y		Y	Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y		Y							Y		Y					Y		Y		Y								Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
		SGS AXYS MLA-901	MLA-901	Y																														
	PCB congeners, total	EPA 1668	MLA-010							Y																		Y						
	Sum - Dichlorobiphenyls (BZ-12 + BZ-13)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Heptachlorobiphenyls (BZ-171 + BZ-173)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Heptachlorobiphenyls (BZ-180 + BZ-193)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Heptachlorobiphenyls (BZ-183 + BZ-185)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-128 + BZ-166)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-129 + BZ-138 + BZ-160 + BZ-163)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-134 + BZ-143)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-135 + BZ-151 + BZ-154)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-139 + BZ-140)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-147 + BZ-149)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-153 + BZ-168)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Hexachlorobiphenyls (BZ-156 + BZ-157)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-107 + BZ-124)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-108 + BZ-124)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-110 + BZ-115)	EPA 1668	MLA-010											Y							Y												Y	

Accreditation Scope

SGS AXYS Analytical Services Ltd.
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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-83 + BZ-99)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-85 + BZ-116 + BZ-117)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-86 + BZ-87 + BZ 97 + BZ-109 + BZ-119 + BZ-125)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-86 + BZ-87 + BZ-97 + BZ-108 + BZ-119 +BZ-125)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-88 + BZ-91)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-90 + BZ-101 + BZ-113)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Pentachlorobiphenyls (BZ-93 + BZ-95 + BZ-98 + BZ-100 + BZ-102)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Tetrachlorobiphenyls (BZ-40 + BZ-41 + BZ-71)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Tetrachlorobiphenyls (BZ-44 + BZ-47 + BZ-65)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Tetrachlorobiphenyls (BZ-45 + BZ-51)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Tetrachlorobiphenyls (BZ-49 + BZ-69)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Tetrachlorobiphenyls (BZ-50 + BZ-53)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Tetrachlorobiphenyls (BZ-59 + BZ-62 + BZ-75)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Tetrachlorobiphenyls (BZ-61 + BZ-70 + BZ-74 + BZ-76)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Trichlorobiphenyls (BZ-18 + BZ-30)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Trichlorobiphenyls (BZ-20 + BZ-28)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Trichlorobiphenyls (BZ-21 + BZ-33)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Sum - Trichlorobiphenyls (BZ-26 + BZ-29)	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Total Dichlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total Heptachlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total Hexachlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total Monochlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
	Total Nonachlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total Octachlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total PCBs	EPA 1668	MLA-010											Y							Y												Y	
		SGS AXYS MLA-010	MLA-010											Y							Y												Y	
	Total Pentachlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total Polychlorinated biphenyls	SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total Tetrachlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
	Total Trichlorobiphenyls	EPA 1668	MLA-010											Y							Y												Y	
		EPA 8270	MLA-007									Y																						
		SGS AXYS MLA-010	MLA-010	Y	Y									Y		Y					Y		Y										Y	
		SGS AXYS MLA-007	MLA-007		Y											Y							Y											
PCDDF	"Dioxins and Dibenzofurans" category (CA only)	EPA 1613	MLA-017																					Y										
		EPA 8290	MLA-017			Y																												
	1,2,3,4,6,7,8-HpCDD	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,4,6,7,8-HpCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,4,7,8,9-HpCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,4,7,8-HxCDD	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,4,7,8-HxCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,6,7,8-HxCDD	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,6,7,8-HxCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,7,8,9-HxCDD	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	

Accreditation Scope

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	1,2,3,7,8,9-HxCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,7,8-PeCDD	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	1,2,3,7,8-PeCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	2,3,4,6,7,8-HxCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	2,3,4,7,8-PeCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	2,3,7,8-TCDD	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	2,3,7,8-TCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	OCDD	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	OCDF	EPA 1613	MLA-017									Y		Y							Y				Y		Y	Y	Y	Y	Y		Y	
		EPA 8290	MLA-017				Y		Y	Y	Y		Y	Y			Y		Y	Y	Y				Y			Y	Y				Y	
		SGS AXYS MLA-017	MLA-017	Y	Y		Y							Y		Y	Y				Y		Y		Y								Y	
	Total HpCDD	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
	Total HpCDF	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
	Total HxCDD	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
	Total HxCDF	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
	Total PCDD	EPA 1613	MLA-017											Y							Y												Y	
		EPA 8290	MLA-017											Y							Y												Y	
		SGS AXYS MLA-017	MLA-017											Y							Y												Y	
	Total PCDD+PCDF	EPA 1613	MLA-017											Y							Y												Y	
		EPA 8290	MLA-017											Y							Y												Y	
		SGS AXYS MLA-017	MLA-017											Y							Y												Y	
	Total PCDF	EPA 1613	MLA-017											Y							Y												Y	
		EPA 8290	MLA-017											Y							Y												Y	
		SGS AXYS MLA-017	MLA-017											Y							Y												Y	
	Total PeCDD	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	

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Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum CALA	Solids CALA	Solids California DPH	Solids Florida DOH	Solids Minnesota DOH	Solids New Jersey DEP	Solids New York DOH	Solids Virginia DGS	Solids Washington DE	Solids Maine DOH	Solids ANAB ISO 17025	Solids ANAB DoD **	Tissue CALA	Tissue Florida DOH	Tissue Minnesota DOH	Tissue New Jersey DEP	Tissue Virginia DGS	Tissue ANAB ISO 17025	Urine CALA	Water CALA	Water, Non-Potable California DPH	Water, Non-Potable Florida DOH	Water, Non-Potable Minnesota DOH	Water, Non-Potable New Jersey DEP	Water, Non-Potable New York DOH	Water, Non-Potable Virginia DGS	Water, Non-Potable Washington DE *	Water, Non-Potable Maine DOH	Water, Non-Potable Pennsylvania DEP	Water, Non-Potable ANAB ISO 17025	Water, Non-Potable ANAB DoD **
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
	Total PeCDF	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
	Total TCDD	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
	Total TCDF	EPA 1613	MLA-017											Y							Y				Y						Y		Y	
		EPA 8290	MLA-017				Y		Y		Y		Y	Y			Y		Y	Y	Y				Y				Y				Y	
		SGS AXYS MLA-017	MLA-017				Y							Y			Y				Y				Y								Y	
PFAS	4:2 Fluorotelomersulfonate (4:2 FTS)	SGS AXYS MLA-081	MLA-081																														Y	
		SGS AXYS MLA-089	MLA-089											Y																				
		SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	6:2 Fluorotelomersulfonate (6:2 FTS)	SGS AXYS MLA-081	MLA-081																														Y	
		SGS AXYS MLA-089	MLA-089											Y																				
		SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	8:2 Fluorotelomersulfonate (8:2 FTS)	SGS AXYS MLA-081	MLA-081																														Y	
		SGS AXYS MLA-089	MLA-089											Y																				
		SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	N-Ethylperfluorooctanesulfonamide (N-EtFOSA)	SGS AXYS MLA-110	MLA-110		Y							Y											Y							Y				
	N-Ethylperfluorooctanesulfonamidoacetic acid (N-EtFOSAA)	SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	N-Ethylperfluorooctanesulfonamidoethanol (N-EtFOSE)	SGS AXYS MLA-110	MLA-110		Y							Y											Y							Y				
	N-Methylperfluorooctanesulfonamide (N-MeFOSA)	SGS AXYS MLA-110	MLA-110		Y							Y											Y							Y				
	N-Methylperfluorooctanesulfonamidoacetic acid (N-MeFOSAA)	SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	N-Methylperfluorooctanesulfonamidoethanol (N-MeFOSE)	SGS AXYS MLA-110	MLA-110		Y							Y											Y							Y				
	Perfluorobutanesulfonate (PFBS)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorobutanoate (PFBA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorodecanesulfonate (PFDS)	SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	Perfluorodecanoate (PFDA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorododecanesulfonate (PFDoS)	SGS AXYS MLA-110	MLA-110		Y							Y											Y							Y				
	Perfluorododecanoate (PFDoA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluoroheptanesulfonate (PFHpS)	SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	Perfluoroheptanoate (PFHpA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorohexanesulfonate (PFHxS)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorohexanoate (PFHxA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorononanesulfonate (PFNS)	SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	Perfluorononanoate (PFNA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorooctanesulfonamide (PFOSA), a.k.a FOSA	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorooctanesulfonate (PFOS)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorooctanoate (PFOA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluoropentanesulfonate (PFPeS)	SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y	Y								Y		Y					Y			Y	Y
	Perfluoropentanoate (PFPeA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
	Perfluorotetradecanoate (PFTeDA)	SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y									Y		Y	Y				Y			Y	Y
	Perfluorotridecanoate (PFTrDA)	SGS AXYS MLA-110	MLA-110		Y		Y					Y		Y									Y		Y					Y			Y	Y
	Perfluoroundecanoate (PFUnA)	SGS AXYS MLA-060	MLA-060																				Y		Y	Y	Y						Y	
		SGS AXYS MLA-041	MLA-041		Y		Y	Y	Y					Y																				
		SGS AXYS MLA-043	MLA-043													Y	Y	Y	Y		Y													
		SGS AXYS MLA-042	MLA-042	Y																														
		SGS AXYS MLA-110	MLA-110		Y		Y	Y				Y		Y	Y								Y		Y	Y				Y			Y	Y
PPCP	1,7-Dimethylxanthine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	10-hydroxy-amitriptyline	SGS AXYS MLA-075	MLA-075		Y																		Y											

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	2-hydroxy-ibuprofen	SGS AXYS MLA-075	MLA-075		Y																		Y											
	4-Epianhydrochlortetracycline (EACTC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	4-Epianhydrotetracycline (EATC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	4-Epichlortetracycline (ECTC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	4-Epioxytetracycline (EOTC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	4-Epitetracycline (ETC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Acetaminophen	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Albuterol	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Alprazolam	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Amitriptyline	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Amlodipine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Amphetamine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Anhydrochlortetracycline (ACTC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Anhydrotetracycline (ATC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Atenolol	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Atorvastatin	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Azithromycin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Benzoylecgonine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Benztropine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Betamethasone	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Bisphenol A	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Caffeine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Carbadox	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Carbamazepine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Cefotaxime	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Chlortetracycline (CTC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Cimetidine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Ciprofloxacin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Clarithromycin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Clinafloxacin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	Clonidine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Cloxacillin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Cocaine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Codeine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Cotinine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	DEET (N,N-diethyl-m-toluamide)	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Dehydronifedipine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Demeclocycline	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Desmethyldiltiazem	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Diazepam	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Digoxigenin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Digoxin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Diltiazem	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Diphenhydramine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Doxycycline	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Enalapril	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Enrofloxacin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Erythromycin	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Erythromycin anydrate	EPA 1694	MLA-075										Y																		Y			
	Flumequine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Fluocinonide	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Fluoxetine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Fluticasone propionate	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Furosemide	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Gemfibrozil	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Glipizide	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Glyburide	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Hydrochlorothiazide	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Hydrocodone	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Hydrocortisone	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Ibuprofen	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Isochlortetracycline (ICTC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Lincomycin	EPA 1694	MLA-075										Y																		Y			

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Lomefloxacin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Meprobamate	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Metformin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Methylprednisolone	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Metoprolol	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Miconazole	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Minocycline	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Naproxen	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Norfloxacin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Norfluoxetine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Norgestimate	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Norverapamil	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Ofloxacin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Ormetoprim	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Oxacillin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Oxolinic acid	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Oxycodone	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Oxytetracycline (OTC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Paroxetine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Penicillin G	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Penicillin V	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Prednisolone	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Prednisone	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Promethazine	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Propoxyphene	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Propranolol	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Ranitidine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Roxithromycin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sarafloxacin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sertraline	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Simvastatin	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfachloropyridazine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfadiazine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfadimethoxine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	Sulfamerazine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfamethazine	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfamethizole	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfamethoxazole	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfanilamide	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Sulfathiazole	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Tetracycline (TC)	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Theophylline	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Thiabendazole	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Trenbolone	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Trenbolone acetate	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Triamterene	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Triclocarban	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Triclosan	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Trimethoprim	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Tylosin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Valsartan	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Verapamil	SGS AXYS MLA-075	MLA-075		Y																		Y											
	Virginiamycin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
	Warfarin	EPA 1694	MLA-075										Y																		Y			
		SGS AXYS MLA-075	MLA-075		Y																		Y											
Targeted Metabolites	11, 14, 17-eicosatrienoic acid (eicosatrienoic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	11, 14-eicosadienoic acid	SGS AXYS MLM-001	MLM-001													Y																		
	3-hydroxytyrosine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Acetylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Acetylornithine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Alanine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	alpha-Aminoadipic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Arginine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Asparagine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Aspartate	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Asymmetric dimethylarginine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Butenylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Butyrylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	C22:5 ISOMER 1 (tentatively all-cis-4, 8, 12, 15, 19-docosapentaenoic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	C22:5 ISOMER 2 (all-cis-7,10,13,16,19-docosapentaenoic acid (DPA)	SGS AXYS MLM-001	MLM-001													Y																		
	C22:5 ISOMER 3 (tentatively all-cis-4, 7, 10, 13, 16-docosapentaenoic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Carnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Carnosine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	chenodeoxycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	cholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Citrulline	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Creatinine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Decadienylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	decanoic acid (capric acid)	SGS AXYS MLM-001	MLM-001													Y																		

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	Decanoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Decenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	deoxycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	docosahexaenoic acid (DHA)	SGS AXYS MLM-001	MLM-001													Y																		
	docosatetraenoic acid (adrenic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Dodecanedioylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Dodecanoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Dodecenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Dopamine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	eicosapentaenoic acid (EPA)	SGS AXYS MLM-001	MLM-001													Y																		
	Eicosatetraenoic acid (arachidonic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	eicosatrienoic acid (dihomo-γ-linolenic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Glutaconylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Glutamate	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Glutamine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Glutarylcarnitine (Hydroxyhexanoylcarnitine)	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Glycine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	glycochenodeoxycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	glycocholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	glycodeoxycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hexadecadienylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	hexadecanoic acid (palmitic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Hexadecanoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	hexadecenoic acid (palmitoleic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Hexadecenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hexanoylcarnitine (Fumarylcarnitine)	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hexenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hexose (sum isomers)	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Histamine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Histidine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxyhexadecadienylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxyhexadecanoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxyhexadecenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxybutyrylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxyoctadecenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxyproline	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxypropionylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxysphingomyeline C14:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxysphingomyeline C16:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxysphingomyeline C22:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxysphingomyeline C22:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxysphingomyeline C24:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxytetradecadienylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxytetradecenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Hydroxyvalerylcarnitine (Methylmalonylcarnitine)	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Isoleucine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Kynurenine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Leucine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lithocholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Lysine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C14:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C16:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C16:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C17:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C18:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C18:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C18:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C20:3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum: CALA	Solids: CALA	Solids: California DPH	Solids: Florida DOH	Solids: Minnesota DOH	Solids: New Jersey DEP	Solids: New York DOH	Solids: Virginia DGS	Solids: Washington DE	Solids: Maine DOH	Solids: ANAB ISO 17025	Solids: ANAB DoD **	Tissue: CALA	Tissue: Florida DOH	Tissue: Minnesota DOH	Tissue: New Jersey DEP	Tissue: Virginia DGS	Tissue: ANAB ISO 17025	Urine: CALA	Water: CALA	Water, Non-Potable: California DPH	Water, Non-Potable: Florida DOH	Water, Non-Potable: Minnesota DOH	Water, Non-Potable: New Jersey DEP	Water, Non-Potable: New York DOH	Water, Non-Potable: Virginia DGS	Water, Non-Potable: Washington DE *	Water, Non-Potable: Maine DOH	Water, Non-Potable: Pennsylvania DEP	Water, Non-Potable: ANAB ISO 17025	Water, Non-Potable: ANAB DoD **
	lysoPhosphatidylcholine acyl C20:4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C24:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C26:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C28:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	lysoPhosphatidylcholine acyl C28 1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Methionine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Methioninesulfoxide	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Methylglutarylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Nitrotyrosine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Nonaylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	octadecadienoic acid (linoleic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Octadecadienylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	octadecanoic acid (stearic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Octadecanoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	octadecatrienoic acid (γ-linolenic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Octadecenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Octanoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Ornithine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phenylalanine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phenylethylamine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C30:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C30:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C30 2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C32:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C32:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C34 0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C34 1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C34:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C34 3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C36:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C36 1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C36:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C36:3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C36 4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C36:5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C38:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C38 1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C38 2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C38 3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C38 5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C38:6	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C40 1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C40:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C40:3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C40 4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C40 5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C40 6	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C42 0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C42:1	SGS AXYS MLM-001	MLM 001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C42 2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C42 3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C42 4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C42 5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C44 3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C44.4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C44 5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine acyl-alkyl C44 6	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C24:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												

Accreditation Scope

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				Serum	Solids											Tissue						Urine	Water	Water, Non-Potable										
Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB ISO 17025	ANAB DoD **	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB ISO 17025	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	Pennsylvania DEP	ANAB ISO 17025	ANAB DoD **
	Phosphatidylcholine diacyl C26:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C28:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C30:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C30.2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C32 0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C32 1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C32:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C32 3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C34:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C34:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C34:3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C34:4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C36:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C36:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C36 2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C36:3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C36:4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C36:5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C36:6	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C38.0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C38:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C38:3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C38:4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C38:5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C38:6	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C40:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C40:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C40:3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C40:4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C40 5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C40:6	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C42:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C42:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C42:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C42 4	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C42.5	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Phosphatidylcholine diacyl C42 6	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Pimelylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Proline	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Propenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Propionylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Putrescine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sarcosine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Senne	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Serotonin	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Spermidine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Spermine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C16:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C16:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C18:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C18:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C20:2	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C22 3	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C24:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C24:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C26:0	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Sphingomyeline C26:1	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Symmetric dimethylarginine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												

Accreditation Scope

SGS AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 40

Compound Class	Compound	Accredited Method ID	SGS AXYS Method ID	Serum: CALA	Solids: CALA	Solids: California DPH	Solids: Florida DOH	Solids: Minnesota DOH	Solids: New Jersey DEP	Solids: New York DOH	Solids: Virginia DGS	Solids: Washington DE	Solids: Maine DOH	Solids: ANAB ISO 17025	Solids: ANAB DoD **	Tissue: CALA	Tissue: Florida DOH	Tissue: Minnesota DOH	Tissue: New Jersey DEP	Tissue: Virginia DGS	Tissue: ANAB ISO 17025	Urine: CALA	Water: CALA	Water, Non-Potable: California DPH	Water, Non-Potable: Florida DOH	Water, Non-Potable: Minnesota DOH	Water, Non-Potable: New Jersey DEP	Water, Non-Potable: New York DOH	Water, Non-Potable: Virginia DGS	Water, Non-Potable: Washington DE *	Water, Non-Potable: Maine DOH	Water, Non-Potable: Pennsylvania DEP	Water, Non-Potable: ANAB ISO 17025	Water, Non-Potable: ANAB DoD **
	Taurine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	taurochenodeoxycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	taurocholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	taurodeoxycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	taurolithocholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	tauroursodeoxycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Tetradecadienylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	tetradecanoic acid (myristic acid)	SGS AXYS MLM-001	MLM-001													Y																		
	Tetradecanoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Tetradecenoylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Threonine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Tiglylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Total dimethylarginine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Tryptophan	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Tyrosine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	ursodexoycholic acid	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Valerylcarnitine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
	Valine	SGS AXYS MLM-001	MLM-001	Y												Y						Y												
TBBPA	Tetrabromobisphenol A	SGS AXYS MLA-079	MLA-079	Y																														
TOP	Perfluorobutanesulfonate (PFBS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorobutanoate (PFBA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorodecanesulfonate (PFDS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorodecanoate (PFDA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorododecanesulfonate (PFDoS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorododecanoate (PFDoA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluoroheptanesulfonate (PFHpS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluoroheptanoate (PFHpA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorohexanesulfonate (PFHxS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorohexanoate (PFHxA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorononanesulfonate (PFNS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorononanoate (PFNA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorooctanesulfonate (PFOS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorooctanoate (PFOA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluoropentanesulfonate (PFPeS)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluoropentanoate (PFPeA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorotetradecanoate (PFTeDA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluorotridecanoate (PFTrDA)	SGS AXYS MLA-111	MLA-111		Y																		Y											
	Perfluoroundecanoate (PFUnA)	SGS AXYS MLA-111	MLA-111		Y																		Y											

Note * Analysis of pesticides and PCBs in non-potable water samples by AXYS method MLA-007, with the exception of NPDES or State permitted discharges and Stormwater applications, may fall within the scope of Washington State Department of Ecology solids matrix accreditation, subject to approval of the Ecology Project Manager.

Note ** PFAS by LC-MS/MS compliant with US DoD QSM 5.1 table B-15

Legend	
Y	Accreditation scope
BFR	Brominated flame retardants (non-PBDPE)
BPA and mPE	Bisphenol A and mono-Phthalate Esters
HBCDD	Hexabromocyclododecane
OC Pesticides	Organochlorine Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PBDPE	Polybrominated diphenylethers
PCB	Polychlorinated Biphenyls
PCDDF	Polychlorinated dibenzodioxins/furans
PFAS	Per- and Polyfluoroalkyl Substances
PPCP	Pharmaceutical and Personal Care Products
TBBPA	Tetrabromobisphenol A
TOP	Total Oxidizable Precursors
California DPH	California Department of Public Health, Lab ID 2911
Florida DOH	Florida Department of Health, Lab ID E871007, (NELAC Standard)
Pennsylvania DEP	Pennsylvania Department of Environmental Protection
Minnesota DOH	Minnesota Department of Health, Lab ID 232-999-430, (NELAC Standard)
New Jersey DEP	New Jersey Department of Environmental Protection, Lab ID CANA005, (NELAC Standard)
New York DOH	New York Department of Health, Lab ID 11674, (NELAC Standard)
Washington DE	Washington Department of Ecology, Lab ID C404
Virginia DGS	Virginia Department of General Services, Division of Consolidated Laboratory Services, Lab ID 460224, (NELAC Standard)
Maine DOH	Maine Center for Disease Control and Prevention, Department of Health and Human Services, Lab ID CN00003
ANAB DoD	ANSI-ASQ National Accreditation Board, certificate ADE-1861, (US DoD QSM 5.1 Standard)
CALA	Canadian Association for Laboratory Accreditation Inc., Lab ID A2637, (ISO/IEC 17025:2005 Standard)
ANAB ISO 17025	ANSI-ASQ National Accreditation Board, certificate ADE-1861.01, (ISO/IEC 17025:2005 Standard)

ANAB ACCREDITED ISO/IEC 17025 DOD ELAP Certificate ADE-1861

ilac-MRA

CALA Testing Accreditation No. A 2637

ilac-MRA

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY Certificate ADE-1861.01

ilac-MRA

Appendix A11

Phytoplankton and Zooplankton Data

Table A11.1 Algal density (number of units/L) and biomass (micrograms/m³) in Horizon Lake, 2018.

	HZL, Rep 1		HZL, Rep 2		HZL, Rep 3		HZL, Rep 1		HZL, Rep 2		HZL, Rep 3		HZL, Rep 1		HZL, Rep 2		HZL, Rep 3		HZL, Rep 1	
	16-May-18		16-May-18		16-May-18		10-Jul-18		10-Jul-18		10-Jul-18		6-Sep-18		6-Sep-18		6-Sep-18		6-Sep-18	
	bio-01		bio-02		bio-03		bio-04		bio-05		bio-06		bio-07		bio-08		bio-09		bio-10QA	
	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
DIATOMS																				
Achnanthes minutissima Kuetzing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17016	0.953
Astenonella formosa Hansall	0	0	0	0	13613	32.67256	0	0	0	0	8508	15.99594	0	0	0	0	0	0	17016	6.126
Aulacoseira granulata var angustissima (O. Muller) Simonsen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34033	141.135
Aulacoseira distans (Ehrenberg) Simonsen	54454	82.1151	40840	68 42926	47647	27.3717	425424	232.8733	331830	301 0887	391390	400.3112	737401	595 3345	867864	912 2476	1038034	889.1527	748746	542 73
Aulacoseira granulata (Ehrenberg) Simonsen	6806	10.26439	0	0	0	0	0	0	8508	128 3048	0	0	124791	2591 188	22689	727 0609	68067	2044 859	850848	721 715
Centric Diatom (6-12 um)- (*Stephanodiscus parvus* Stoermer & Hakansson)	34033	13.36509	74874	29 4032	74874	29 4032	59558	15 53023	42541	11.46725	51049	14 80852	11344	4 455029	56723	22.27515	51050	20 04763	0	0
Cymbella sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11344	2 475016	0	0	0	0
Fragilaria crotonensis Kitton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11344	6.897541	0	0	0	0
Gyrosgima sp	6806	88.48819	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Navicula sp	6806	5.445427	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitzschia acicularis (Kuetzing) W. Smith	0	0	0	0	0	0	8508	0.765763	0	0	8508	1.701696	0	0	11344	2.359685	0	0	17016	1.914
Nitzschia sp	0	0	0	0	13613	1.633628	0	0	0	0	0	0	0	0	0	0	0	0	17016	2.042
Rhizosolenia eriensis H.L. Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17016	16.038
Rhizosolenia longiseta Ehrenberg	0	0	0	0	0	0	0	0	34033	1.202858	0	0	45378	10.26439	34033	5.346035	17016	1.49689	68067	5.988
Stephanodiscus sp	6806	21.38414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synedra sp	0	0	0	0	0	0	8508	1.531526	17016	6.126105	0	0	11344	2.093086	11344	2.118611	17016	3.445934	17016	3.293
Synedra ulna (Nitzsch) Ehr.	0	0	0	0	0	0	0	0	8508	15.31526	0	0	0	0	0	0	0	0	0	0
CHLOROPHYCEAE																				
Ankistrodesmus fusiformis Corda	0	0	0	0	0	0	0	0	0	0	8508	0.801905	0	0	0	0	17016	4.811432	0	0
Ankistrodesmus gracilis (Reinsch) Kors.	0	0	0	0	0	0	59559	1.621631	42542	1.113757	25525	0.668254	0	0	0	0	34033	0.8910059	0	0
Ankyra lanceolata (Kors) Fott	0	0	0	0	0	0	0	0	0	0	8508	0.178201	0	0	0	0	0	0	0	0
Chlamydomonas globosa Snow	6806	4.276828	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coelastrum microporum Naegeli	0	0	6806	28.51219	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crucigenia quadrata Morren	0	0	0	0	0	0	0	0	8508	1.140488	0	0	0	0	0	0	0	0	0	0
Elakatothrix genevensis (Reverdin) Hindak	0	0	0	0	0	0	0	0	17016	2.673018	8508	0.481143	0	0	0	0	0	0	0	0
Monoraphidium braunii Naegeli	6806	7.13E-02	0	0	6806	0.128305	0	0	0	0	8508	9.80E-02	0	0	0	0	0	0	0	0
Monoraphidium dybowskii (Wolosz) Hindak et. Kom.-Legn.	0	0	0	0	0	0	34033	0.641524	93593	2.20524	144644	1.211768	0	0	34033	0.8019053	102101	2.405716	0	0
Monoraphidium griffithii (Berkeley) Komarkova-Legenerova	0	0	0	0	0	0	0	0	0	0	17016	0.891006	11344	1.336509	0	0	0	0	0	0
Monoraphidium minutum (Nag) Komarkova-Legenerova	0	0	0	0	0	0	0	0	0	0	0	0	11344	0.2138414	0	0	17016	0 7217148	0	0
Monoraphidium setiforme (Nygaard) Komarkova-Legenerova	6806	0.142561	0	0	0	0	0	0	8508	0.213841	0	0	0	0	0	0	0	0	0	0
Oocystis borgei Snow	0	0	0	0	0	0	0	0	8508	3.991707	34033	15 96683	0	0	0	0	0	0	0	0
Oocystis parva W. & G.S West	0	0	0	0	0	0	0	0	25525	0.267302	0	0	11344	0.2376016	79412	1.900813	85084	4.276828	17016	0.713
Scenesdesmus ecornis var. *bicellularis* (Ehrenberg) Chodat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17016	0.428
Scenedesmus incrassatulus Bohlin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22689	7.603251	0	0	0	0
Scenedesmus opoliensis P.G. Richter	0	0	0	0	0	0	0	0	0	0	0	0	11344	3.801625	0	0	0	0	0	0
Scenedesmus arcuatus var. *platydisca* G. M. Smith	0	0	0	0	0	0	17016	20.84954	0	0	0	0	0	0	22689	21.38414	34033	61.58633	0	0
Tetraedron minimum var *tetralobulatum* Reins	0	0	0	0	0	0	0	0	0	0	8508	0.285122	0	0	0	0	0	0	0	0
Treubaria setigerum (Archer) G M. Smith	0	0	0	0	0	0	0	0	76576	22.52878	0	0	11344	3.0413	22689	20.52878	0	0	0	0
Treubaria triappendiculata Bernard	0	0	0	0	0	0	42542	7.640376	76576	20.52878	25525	6.842926	0	0	0	0	0	0	0	0
CHRYSOPHYCEAE																				
Chromulina sp.	0	0	0	0	0	0	0	0	8508	2.401261	0	0	0	0	0	0	0	0	0	0
Chromulina sp.	0	0	0	0	0	0	0	0	17016	0.481143	17016	0.400953	0	0	0	0	0	0	0	0
Dinobryon bavaricum Imhof	0	0	0	0	0	0	42542	7.796302	59559	6.985487	0	0	0	0	0	0	0	0	0	0
Dinobryon sp (loose monad)	0	0	0	0	0	0	0	0	8508	1.069207	0	0	0	0	0	0	0	0	0	0
Unidentified naked Chrysophyte sp (*Ochromonas/Chromulina*)-large	122522	45.16331	74874	19.21009	68067	31.75545	127627	42.76828	102101	26.19557	161661	41.47632	11344	4.181788	45378	16.72715	34033	8.731857	17016	5.702
Unidentified naked Chrysophyte sp (*Ochromonas/Chromulina*)-small	0	0	0	0	0	0	42542	1.002382	17016	0.400953	17016	0.360857	0	0	0	0	0	0	0	0
Haptophyte (*Erkenia/Chrysochromulina*)	0	0	0	0	0	0	8508	0.160381	8508	5.35E-02	0	0	0	0	0	0	0	0	0	0

Table A11.1 (Cont'd.)

	HZL, Rep 1		HZL, Rep 2		HZL, Rep 3		HZL, Rep 1		HZL, Rep 2		HZL, Rep 3		HZL, Rep 1		HZL, Rep 2		HZL, Rep 3		HZL, Rep 1	
	16-May-18		16-May-18		16-May-18		10-Jul-18		10-Jul-18		10-Jul-18		6-Sep-18		6-Sep-18		6-Sep-18		6-Sep-18	
	bio-01		bio-02		bio-03		bio-04		bio-05		bio-06		bio-07		bio-08		bio-09		bio-10QA	
	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
CHRYSOPHYCEAE (Cont'd.)																				
Mallomonas caudata Iwanoff	0	0	0	0	0	0	0	0	8508	81 97254	0	0	0	0	22689	371 2525	17016	142 5609	34033	173 212
Mallomonas sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22689	21.38414	0	0	0	0
Pedinella sp	0	0	0	0	0	0	8508	2.280975	0	0	8508	2.280975	0	0	0	0	0	0	0	0
Spiniferomonas bourrellyi Takahashi	0	0	0	0	0	0	8508	4.455029	0	0	0	0	0	0	0	0	0	0	0	0
Uroglena sp	0	0	0	0	6806	1.283049	8508	1.603811	8508	1.764192	0	0	0	0	0	0	0	0	0	0
CRYPTOPHYCEAE																				
Cryptomonas erosa Ehrenberg	47647	109.6222	27227	49.26907	6806	16.26264	8508	15 39658	0	0	17016	23 71858	11344	34.92743	0	0	17016	36.1392	34033	51 75
Cryptomonas marssonii Skuja	0	0	0	0	6806	5.702438	8508	5.773718	8508	5.773718	0	0	0	0	0	0	0	0	0	0
Cyrptomonas phaseolus Skuja	0	0	0	0	0	0	0	0	8508	3.05615	0	0	0	0	0	0	0	0	0	0
Cryptomonas pyrenoidifera Geitler	0	0	0	0	0	0	0	0	8508	6.495433	0	0	0	0	0	0	0	0	0	0
Cryptomonas reflexa Skuja	0	0	6806	16.86496	6806	14.37014	0	0	0	0	0	0	0	0	0	0	17016	28.22707	0	0
Katablephans ovalis Skuja	0	0	0	0	0	0	17016	2.227515	42542	3 920426	25525	2.138414	0	0	22689	1.900813	17016	2.227515	17016	2.228
Rhodomonas minuta Skuja	810007	152 6828	1272868	183.2799	496895	65.04343	1191187	171.5186	638136	91.88499	791288	113 9374	283616	37 12525	578576	83 30905	425424	61.25666	289288	41.665
CYANOBACTERIA																				
Anabaena affinis Lemmermann	0	0	0	0	0	0	17016	91 23901	42542	287 5583	17016	168 0883	0	0	0	0	0	0	0	0
Anabaena flos-aquae Brebisson	0	0	0	0	0	0	0	0	0	0	17016	10 69653	0	0	0	0	0	0	17016	15.281
Anabaena mendotae Trelease	0	0	0	0	0	0	0	0	8508	9.979266	8508	7.48445	0	0	0	0	0	0	0	0
Anabaena solitana Klebahn	0	0	0	0	0	0	8508	2.886859	0	0	0	0	0	0	0	0	0	0	0	0
Aphanocapsa delicatissima West & West	0	0	0	0	0	0	0	0	17016	9 979266	34033	3.207621	0	0	0	0	17016	1.425609	17016	4.277
Aphanocapsa elachista W. & G.S. West	0	0	0	0	0	0	0	0	8508	2 405716	34033	6.976576	0	0	11344	3.207621	0	0	0	0
Aphanizomenon flos-aquae f. gracile (Lemmermann)	0	0	0	0	0	0	102101	2258.166	119118	2051.114	68067	1434.208	102101	2326.167	357356	11002.14	748746	24080 26	272271	4416 895
Aphanizomenon flos-aquae f. *gracile* (Lemmermann)	0	0	0	0	0	0	8508	38.49146	42542	43.30289	0	0	0	0	0	0	0	0	0	0
Aphanizomenon issatschenkoi (Usacev) Proskina-Lavrenko	0	0	0	0	0	0	25525	29 47002	119118	187 3451	119118	139.3511	0	0	0	0	0	0	0	0
Aphanothece sp	0	0	0	0	0	0	0	0	8508	3.207621	8508	3.207621	0	0	0	0	0	0	0	0
Chroococcus limneticus Lemmermann	0	0	0	0	0	0	0	0	0	0	8508	4.56195	0	0	0	0	0	0	0	0
Limnothrix sp	0	0	6806	0.534604	0	0	42542	12.42953	25525	11.36033	17016	5.346035	90757	62 72681	34033	17.82012	85084	53 99496	34033	17.375
Planktothrix agardhii Gomont	0	0	0	0	27227	52.69053	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planktolyngbya contorta Lemmermann	0	0	0	0	0	0	8508	2.673018	34033	7 350799	0	0	0	0	0	0	0	0	0	0
Pseudanabaena limnetica Komarek	0	0	0	0	0	0	8508	1.336509	0	0	0	0	351683	123.3152	493491	242 1754	510508	206.8916	493491	159 312
Romeria leopoliensis (Raciborski) Koczwara ex. Geitler	0	0	0	0	0	0	170169	6.415243	0	0	8508	0.320762	0	0	0	0	0	0	0	0
Synechocystis sp (bi-cell)-spherical	0	0	0	0	0	0	8508	0.285122	42542	1.425609	17016	0.570244	0	0	11344	0.3801625	17016	0.2405716	0	0
EUGLENOPHYCEAE																				
Trachelomonas dybowskii Dreseposiski	0	0	6806	31.36341	0	0	34033	156.817	8508	28.86859	25525	86 60577	0	0	11344	52.27235	0	0	34033	206 998
Trachemolomas volvocina Ehrenberg	313112	163 9451	387986	203.1494	347145	227.4703	8508	7.698291	8508	7.698291	8508	7.698291	56723	173.2116	79412	285 1991	34033	103 9269	85084	259 817
DINOPHYCEAE																				
Ceratium hirundinella (O.F. Muller) Schrank	0	0	0	0	0	0	3403	513 2194	0	0	5672	594.004	54454	8211.51	68067	12799.3	125925	21362 76	78278	4368 112
Gymnodinium helveticum Pen.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17016	39.204
TOTAL	**1429417**	**697**	**1905893**	**630**	**1123111**	**506**	**2572947**	**3658**	**2229198**	**3402**	**2183820**	**3117**	**1949000**	**14185**	**2966609**	**26630**	**3546315**	**49122**	**3277446**	**11205**

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Table A11.2 Zooplankton density (number of organisms/m³) and biomass (micrograms/m³) in Horizon Lake, 2018.

	HZL Rep 1		HZL Rep 2		HZL Rep 3		HZL Rep 1		HZL Rep 2		HZL Rep 3		HZL, Rep 1		HZL Rep 2		HZL Rep 3		HZL, Rep 2	
	16-May-18		16-May-18		16-May-18		10-Jul-18		10-Jul-18		10-Jul-18		6-Sep-18		6-Sep-18		6-Sep-18		6-Sep-18	
	1		2		3		4		5		6		7		8		9		10QA	
	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
ROTIFERA																				
Ascomorpha ovalis Bergendahl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57704.348	31567.423	34004.348	18602.231	0	0
Asplanchna brightwellei Gosse	0	0	0	0	0	0	0	0	0	0	0	0	115408.696	845781.902	173113.043	1268672.853	68008 696	498407 192	130246.957	954525.289
Asplanchna sp	0	0	0	0	0	0	0	0	5000.000	8143.701	0	0	0	0	0	0	0	0	0	0
Collotheca mutabilis Harring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14426.087	13402.465	0	0	0	0
Conochilus unicornis Rousselet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16280.870	11866.960
Gastropus stylifer Imhof	0	0	0	0	0	0	0	0	5000.000	3644.449	0	0	65947.826	48068.698	0	0	17002.174	12392.711	0	0
Kellicottia longispina Kellicott	36250.000	37541 035	0	0	54545.455	56488 078	48888.889	50630.055	125000.000	129451.846	102826.087	106488.214	98921.739	102444.814	115408.696	119518 949	102013.043	105646.214	65123.478	67442.836
Keratella cochlearis Gosse	0	0	0	0	0	0	101851 852	64736.857	120000.000	76271 788	0	0	0	0	0	0	17002.174	10806.552	0	0
Notholca foliacea Ehrenberg	0	0	4393.939	4082.162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polyathra dolicoptera Idelson	0	0	4393.939	3202.698	0	0	20370.370	14847.755	40000.000	29155.592	0	0	16486.957	12017.174	0	0	0	0	0	0
Polyathra major Burckhardt	8055.556	8695.283	17575.758	18971.526	4545.455	4906.429	12222.222	13192.843	10000.000	10794.144	0	0	148382.609	160166.324	115408.696	124573.808	17002.174	18352.391	48842.609	52721.415
Polyathra vulgaris Carlin	0	0	0	0	0	0	0	0	0	0	4673.913	5045.089	16486.957	17796.258	0	0	51006.522	55057.174	97685.217	105442.830
Synchaeta sp	12083.333	21570.986	39545.455	70595.954	4545.455	8114.477	4074.074	7272.976	0	0	4673.913	8343.800	0	0	0	0	0	0	16280.870	29064.365
Trichocerca multicrinis Kellicott	0	0	0	0	0	0	0	0	0	0	4673.913	7612.590	0	0	0	0	0	0	0	0
Vorticella sp	0	0	8787.879	1822.646	0	0	2884444.444	598247.027	3765000.000	780878.294	5342282.609	1108013.952	181356.522	37614.176	0	0	0	0	16280.870	3376.727
Calanoid nauplii	0	0	0	0	0	0	0	0	0	0	4673.913	15952 079	0	0	14426 087	49236 277	0	0	0	0
Cyclopoid (nauplii)	4027.778	4171.226	4393.939	4550.429	0	0	20370.370	21095.856	85000.000	88027.255	46739.130	48403.734	445147.826	461001.662	577043.478	597594.747	102013.043	105646.214	358179.130	370935.596
Opercularia sp	0	0	0	0	0	0	0	0	0	0	37391 304	11147.314	857321.739	255589 764	1428182.609	425778.141	357045.652	106444.535	0	0
CALANOIDA																				
Diaptomus oregonensis Lilljeborg	0	0	0	0	0	0	27481.481	288551.946	13120.000	137758.277	42231.884	443429.236	2652.174	27847.478	3623.188	38043.002	6652.174	69846.952	3536.232	37129.970
Calanoid copepodid	0	0	0	0	0	0	4907.407	8121.795	4373.333	7237.898	10898.551	18037.181	884 058	1463.122	1449.275	2398.561	0.000	0.000	0.000	0.000
CYCLOPOIDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclops bicuspidatus thomasi S. A. Forbes	5133.333	28976.746	4036.364	22784.549	3454.545	19500.290	18648.148	105265.453	46466.667	262296.002	17028.986	96125.570	15913.043	89826.277	15217.391	85899.445	19217.391	108478.728	13260.870	74855.231
Cyclopoid copepodid	2383.333	3444.927	5806.061	8103.135	4836.364	6990.596	4907.407	7093.284	19133.333	27655.779	10898.551	15753.027	24753.623	35779.481	26811.594	38754.122	25869.565	37392.490	25637.681	37057.319
CLADOCERA																				
Daphnia longiremis Sars	550.000	736.193	1345.455	1800.934	460.606	616.536	0	0	0	0	0	0	4420.290	5916.699	2898.551	3879.803	5173.913	6925.448	3536.232	4733.359
Bosmina longirostris O.F. Muller	0	0	896.970	480.105	0	0	0	0	0	0	0	0	14144.928	7571.110	23913.043	12799.521	11086.957	5934.323	14144.928	7571 110
Cladocera immature	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptodora kindti Focke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diaphanosoma	0	0	0	0	0	0	9814.815	31913 524	8746 667	28440 369	23159 420	75304.398	2652 174	8623 720	6521 739	21205 869	3695 652	12016 659	2652 174	8623 720
Total	**68483**	**105136**	**90976**	**136394**	**72388**	**96616**	**3157981**	**1210969**	**4246840**	**1589755**	**5652152**	**1959656**	**2010881**	**2117509**	**2576148**	**2833325**	**836793**	**1171950**	**811688**	**1765347**

Appendix A12

Benthic Invertebrate Data

Table A12.1 Benthic Invertebrate Data, September 2018.

Major Taxon	Family	Subfamily/ Tribe	Genus/ Species	BEN - 1					BEN - 2					BEN - 3					BEN - 4					BEN - 5					BEN - 6					BEN - 7					BEN - 8					BEN - 9				
				A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Cnidaria	Hydridae		*Hydra*																																	16								8				
Oligochaeta	Enchytraeidae																																	40														
	Naididae	Naidinae									1									40		8								2				420	73	168	154	65	104	24	16	80	56	57	8	32	60	69
	Naididae	Tubificinae							3	1	2	3	5						2		20				5	2	7	3	5	16	19	11	4	188	52	8	31	10						11	9	1	4	
	Lumbriculidae																																	1														
Gastropoda	Physidae		*Physa*																																1													
	Planorbidae		*Helisoma*																															2	1													
	Planorbidae		*Gyraulus*																															2	8	25	11	19				1		24		8		5
Acari - Hydracarina	Hydrozetidae		*Hydrozetes*																										1	1	1																	
	Pionidae		*Piona*					2																																								
	Unionicolidae		*Unionicola*																				2						2		1	2																
Nematoda				1					1																			1	2	2		1		81		8	26	16	17			1		8	16	4		
Ostracoda																									2	6	5	2	2	2		3						8		8			16			4		
Copepoda - Cyclopoida	Cyclopidae			40	33	42	19	49	213	272	212	81	144	363	486	1076	1020	552	20		40	20	19	96	72	62	23	7	21	19	14	28	14	20		16	24	16				24	8	24		4	4	4
Copepoda - Calanoida				4	4	2	3	2	2	10	9	1	2	8	2	8	76	8					3			2	2				4	6	7		8	8						8				4		
Cladocera	Bosminidae		*Bosmina*				3		4	2	9	4	1	1	2		20	8						8						1	3		1															
	Chydoridae				1						1																									24	8							8				
	Daphniidae		*Daphnia*			5		1	10	5	11	4	11	5	2	4	8							12		1	1		2	1	3	4	3															
	Ilyocryptidae		*Ilyocryptus*	12	29	33	30	75	9	9	3		7							40	20	60	34		14	5	5		8	4	3	21	5	20		8		8				8	16	8				
	Macrothricidae																								2	2									16	16	16							24				
	Sididae			2		1	1							2																		4	5															
	Sididae		*Sida cristallina*					2		3	1	1	1				16	4					1	8	2	4	2	1	1		1							8						24		8		
Lepidoptera	Noctuidae																																			2		16			2							
Ephemeroptera	Caenidae		*Caenis*																															2	1	1			1				10	8				
Odonata - Zygoptera	Coenagrionidae (i/d)																																	1														1
	Coenagrionidae		*Enallagma*																																									1				
Odonata - Anisoptera	Aeshnidae		*Aeshna*																															1														
Trichopetra - adult																														1																		
Trichoptera	Leptoceridae		*Oecetis*																						2												1											
	Limnephilidae		*Nemotaulius*																															1														
Coleoptera	Chrysomelidae		*Donacia*																															2														
	Haliplidae		*Haliplus*																																		1	17										
Hemiptera	Corixidae (i/d)																								4		1																					
Diptera	Ceratopogonidae	Ceratopogoninae	*Ceratopogon / Culicoides*																															20														
	Ceratopogonidae	Ceratopogoninae	*Probezzia*							1																1									8			8		8			8					
	Ceratopogonidae	Ceratopogoninae (i/d)																																				8										
	Chaoboridae		*Chaoborus*										3	1	7	6	2	3												1																		

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Table A12.1 (Cont'd.)

Major Taxon	Family	Subfamily/ Tribe	Genus/ Species	BEN - 1					BEN - 2					BEN - 3					BEN - 4					BEN - 5					BEN - 6					BEN - 7					BEN - 8					BEN - 9				
				A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Diptera (Cont'd.)	Tabanidae		*Chrysops*																																					1								
	Chironomidae - pupa																			1						1				1	2						3			1			10	1		1	4	4
	Chironomidae	Chironomini (i/d)																								1				1				2		8	16	8									4	
	Chironomidae	Chironomini	*Chironomus*	68	26	74	12	44	19	16	19	5	19	1		2			42	75	61	35	73	30	25	10	14	7	32	34	23	39	16	91		1	8	65	59	31	47	75	36	22	78	12	22	10
	Chironomidae	Chironomini	*Cryptochironomus*																	20								1						20	8	1	16		1	8	1	1				8		
	Chironomidae	Chironomini	*Cladopelma*																						2		1	1	1					20			16			8	8	8				4		
	Chironomidae	Chironomini	*Dicrotendipes*											1		1				20		20	1	8	4	9	12	4	9	8	6	7	1	96	9	101	70	170	68	57	170	165	321	61	2	40	44	15
	Chironomidae	Chironomini	*Endochironomus*											1																				261	46	161	11	34	24	19	15	45	72	120	16	83	42	73
	Chironomidae	Chironomini	*Glyptotendipes*																													1		6										8		8	1	
	Chironomidae	Chironomini	*Microtendipes*																															35		1	6	1										
	Chironomidae	Chironomini	*Parachironomus*												2																																	
	Chironomidae	Chironomini	*Paratendipes*												1		4		20		20		3	4	24	11	45	8						324	8	64	41	377	481	420	625	265	264		8		24	28
	Chironomidae	Chironomini	*Polypedilum*																						2	4		1	18	26	26	18	1	21	33	8	13	1	17	1	39	9	9	59	159	130	103	14
	Chironomidae	Chironomini	*Tribelos*				1												1	2				6	5		1	2						47	50	33	44	27	20	23	25	10	36	1		1		1
	Chironomidae	Tanytarsini	*Cladotanytarsus*			1													20	20	20		1	24	44	29	29	4	1	3	2	6	1				8	16	8	16	16	8	24	8		4		8
	Chironomidae	Tanytarsini	*Paratanytarsus*																															40	16	65		89			8	16	40	90	41	89	32	49
	Chironomidae	Tanytarsini	*Stempellina*																																		8	8										
	Chironomidae	Tanytarsini	*Tanytarsus*			1	1	2		1	1									20	1		3	8	4	1	2		2	5	1	3	1	24	19	17	41	82		9	16	16	17	59	8	10	8	1
	Chironomidae	Orthocladiinae (i/d)																								1											8											
	Chironomidae	Orthocladiinae	*Corynoneura*																															20	16		8											
	Chironomidae	Orthocladiinae	*Parakiefferiella / Stilocladius*																															180	48		154	80	8		16	16						
	Chironomidae	Orthocladiinae	*Psectrocladius*																																				1					25		7	5	13
	Chironomidae	Orthocladiinae	*Thienemanniella*																																								8					
	Chironomidae	Orthocladiinae	*Cricotopus / Orthocladius*																															20	32	8	8	24	65		2	48	40	9	8	5	17	7
	Chironomidae	Tanypodinae (i/d)																																														4
	Chironomidae	Tanypodinae	*Ablabesmyia*																																	8												1
	Chironomidae	Tanypodinae	*Tanypus*																	2	4	7	3																									
	Chironomidae	Tanypodinae	*Procladius*	17	12	16	5	17	2	7	4		4			1			4	60	3	2	17	20	13	9	3		2	6	20	6			1	3	14	8			1	17	2	11		4		
			Total	*144*	*105*	*175*	*75*	*194*	*263*	*327*	*273*	*98*	*197*	*383*	*502*	*1098*	*1146*	*575*	*109*	*300*	*189*	*152*	*160*	*224*	*226*	*161*	*153*	*42*	*109*	*136*	*129*	*160*	*59*	*2008*	*454*	*779*	*765*	*1189*	*874*	*634*	*1007*	*821*	*993*	*679*	*353*	*471*	*374*	*307*

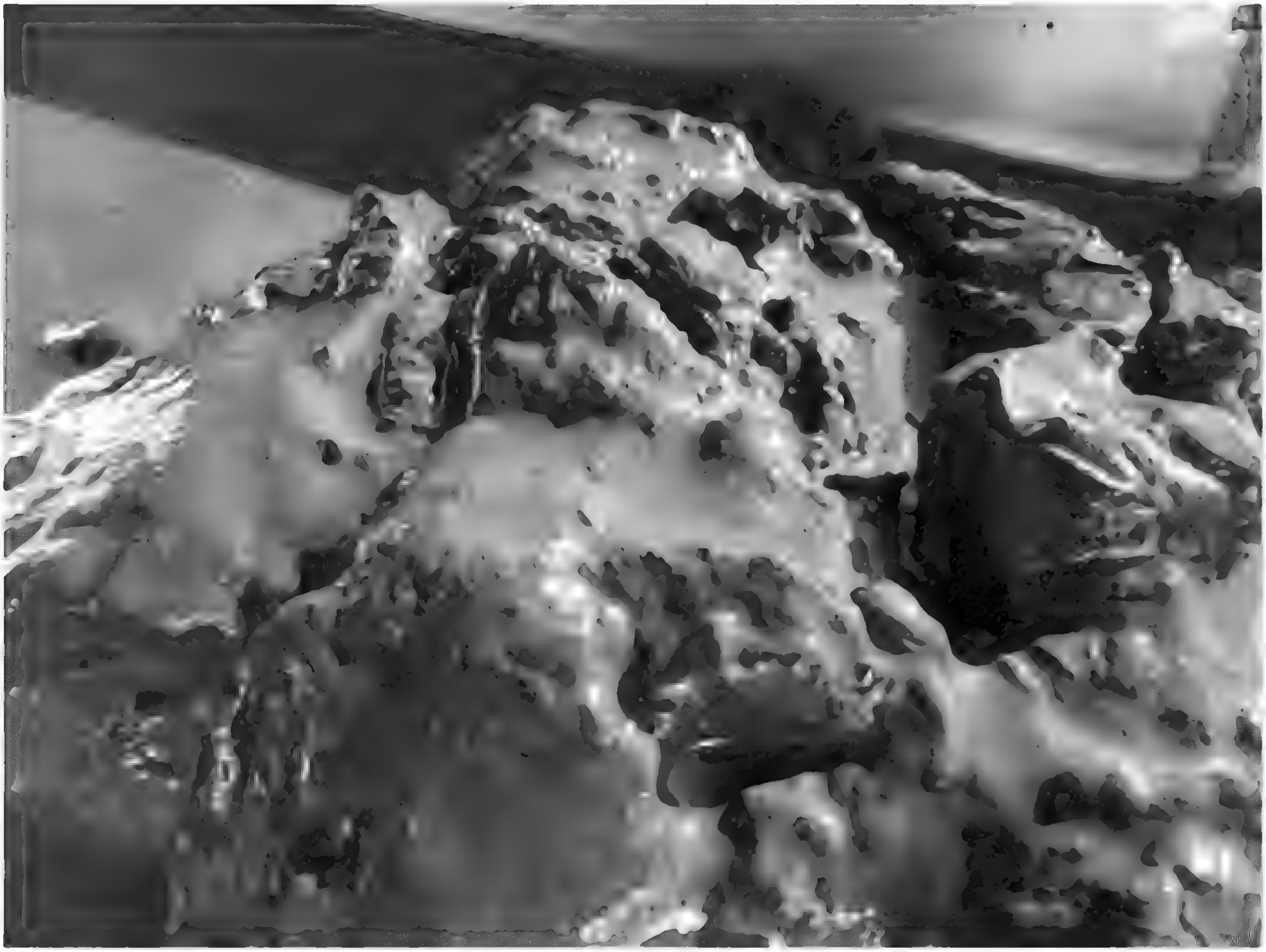
Appendix A13

Life Histories of Fish Species Present in the Tar River

Table A13.1 Life histories of fish species present in the Tar River.

Common Name	Scientific Name	Abbrev.	Spawning Type	Spawning Timing	Spawning Habitat	Life Span	Migration Patterns
Arctic Grayling	*Thymallus arcticus*	ARGR	Single and repeat	Spring (usually shortly after ice-out when temps rise to 4°C)	Flowing water over coarse gravel and cobble substrates	9 y	No info
Brook stickleback	*Culaea inconstans*	BRST	Single (mostly)	Spring through summer (temp >8°C)	Nests created in shallow vegetated areas (lakes and rivers)	3 y	Spring migration from overwintering sites (streams w/deep pools) to smaller streams and ponds
Finescale dace	*Phoxinus neogaeus*	FNDC	Fractional	Early June (temp ~ 12-13°C)	Under cover, depressions, submerged woody debris)	6 y	No info
Fathead minnow	*Pimephales promelas*	FTMN	Single (mostly)	Spring through summer	Nest sites under rocks, logs or sticks	2+y	No info
Lake chub	*Couesius plumbeus*	LKCH	Fractional	Early spring just after ice-out; ~10 C)	Flowing or standing water	5 y	(Northern pop's) migrate from large rivers into tribs in the spring, migrate back to larger rivers in the fall
Longnose sucker	*Catostomus commersonii*	LNSC	Repeat	Early spring (>5°C)	Streams w/gravel; moderate; lake spawn in shallow water	19y	Spring migrations to spawning sites, summer to foraging and fall to overwintering sites
Northern redbelly dace	*Phoxinus eos*	NRDC	Repeat, fractional	Mid-June-July (temps≥ 13°C)	Vegetation in slow streams, bogs, beaver ponds (stained water)	3+y	No info
Pearl dace	*Margaricus margarita*	PRDC	Males: Single Females: may repeat	Spring (May/June - temps > 12°C)	Streams over sand/gravel substrates, and mud/silt substrate	4 y	No info
Slimy sculpin	*Cottus cognatus*	SLSC	Repeat	Spring (temp >4°C)	Under nest rocks (large cobble or boulder substrates)	7+y	Likely none
Trout-perch	*Percopsis omiscomaycus*	TRPR	Repeat, fractional	Spring-summer (May-August – temps 10-17°C)	Lacustrine; riverine	4y	No info
White sucker	*Catostomus catostomus*	WHSC	Repeat	Spring (mid-May to mid-June in BC, temp driven)	Shallow riffles, adjacent to deeper areas; coarse gravel	18 y	Spring spawning migrations to specific streams /or lakes, YOY outmigrate from rearing areas into larger rivers in the summer/fall

Information for this table was gathered from the following sources http //www.fishdb.ca; http //www.fishbase.org/search.php; and McPhail 2007. The Freshwater Fishes of British Columbia. The University of Alberta Press: Edmonton, AB.



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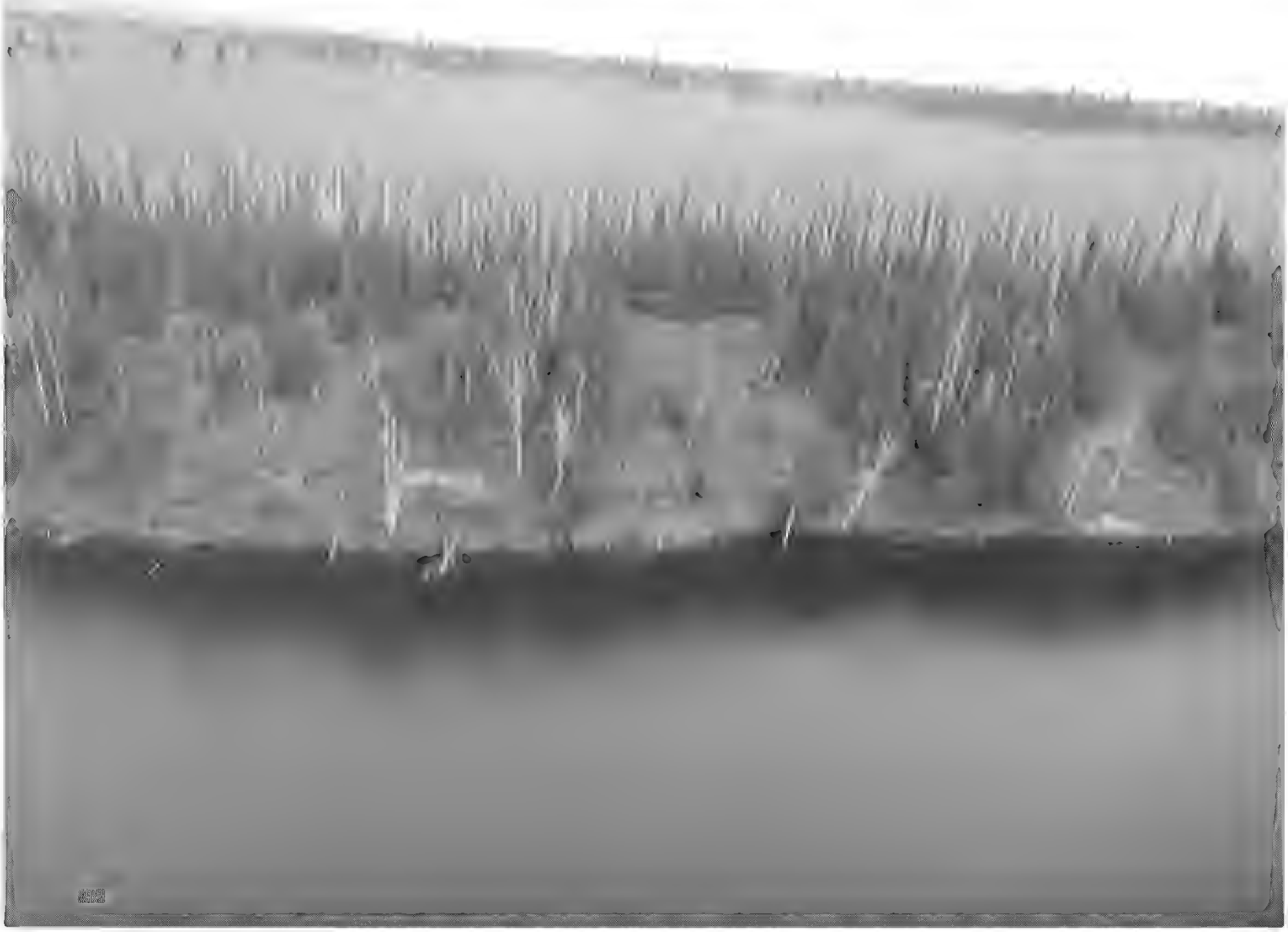

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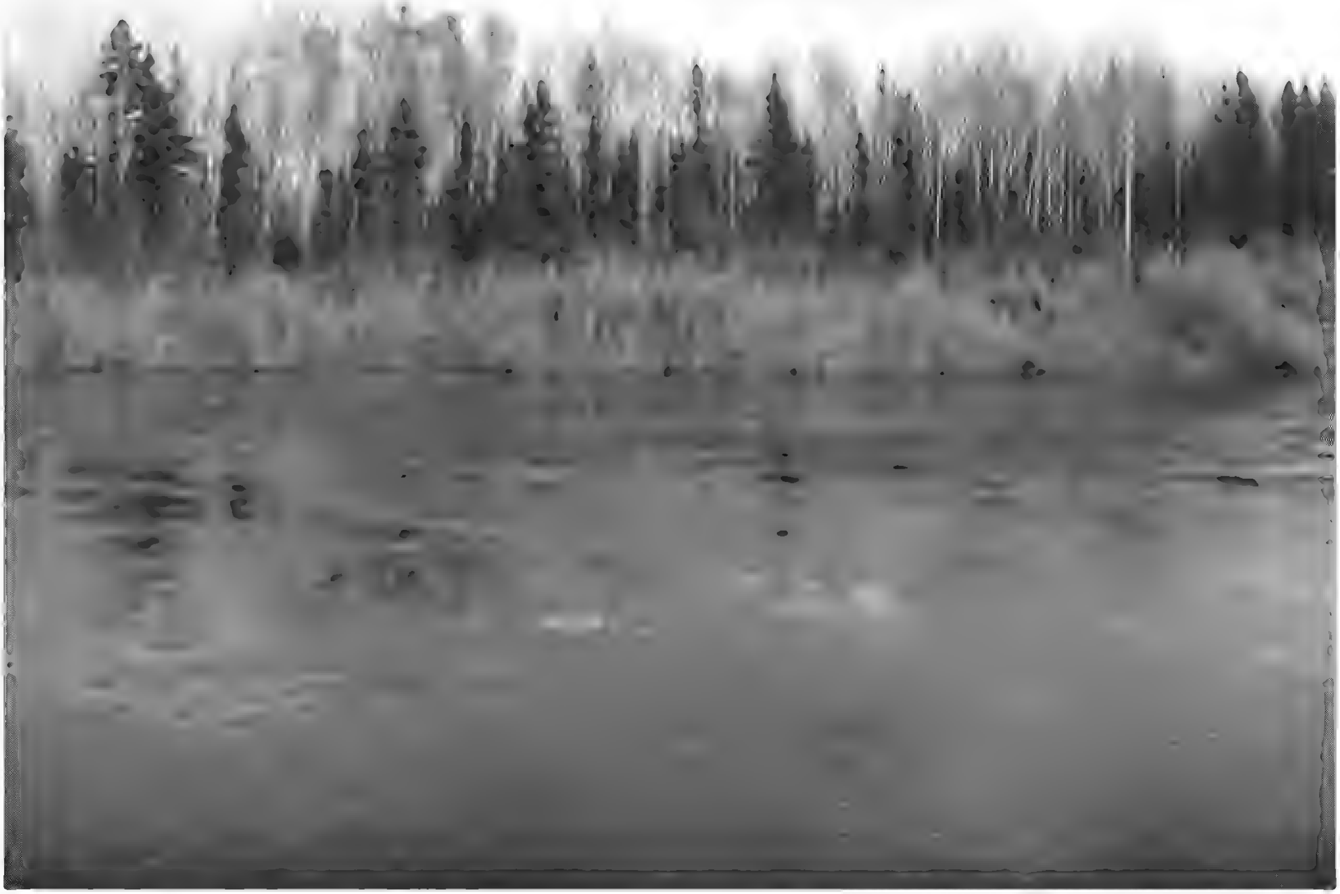
C-GDKD



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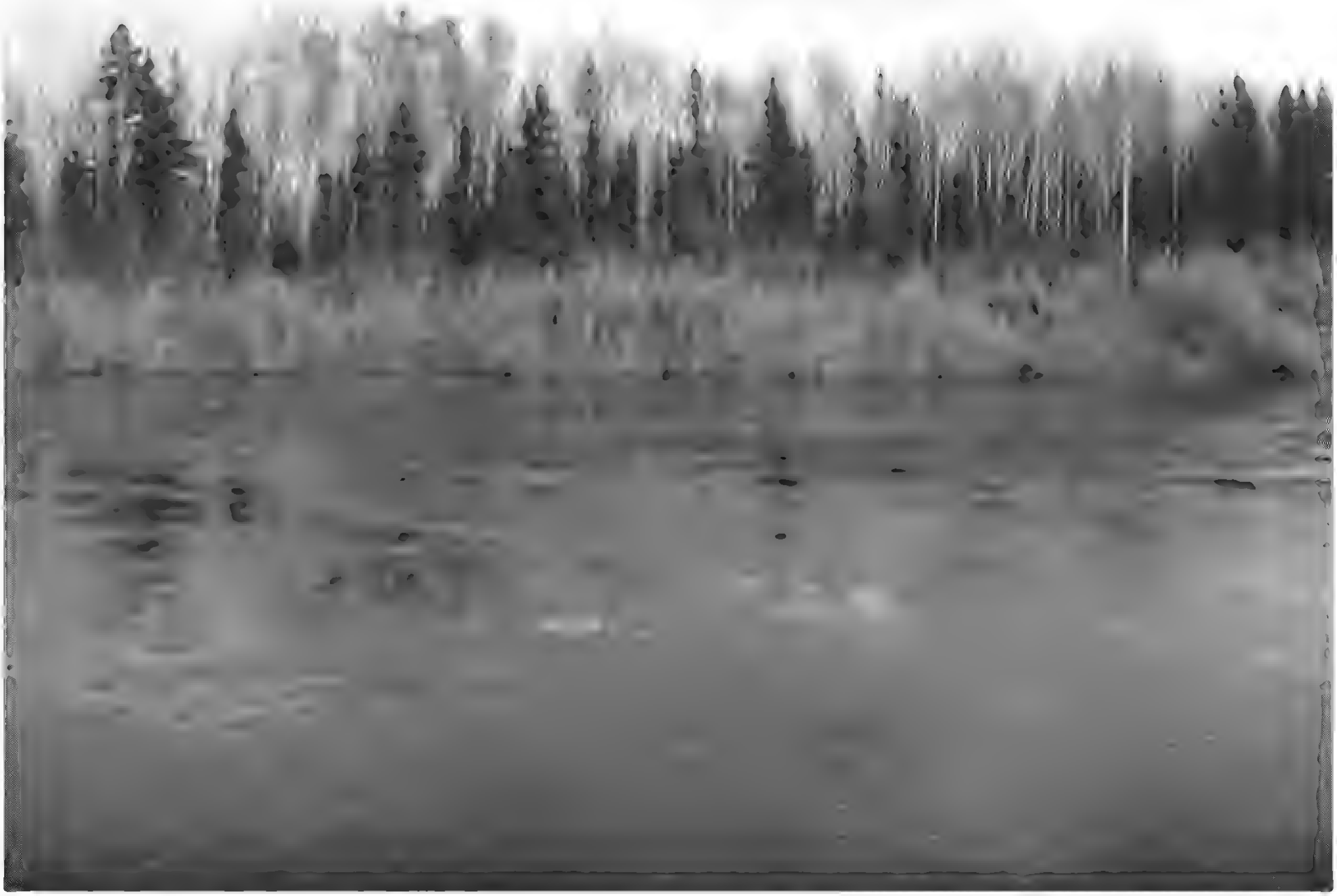

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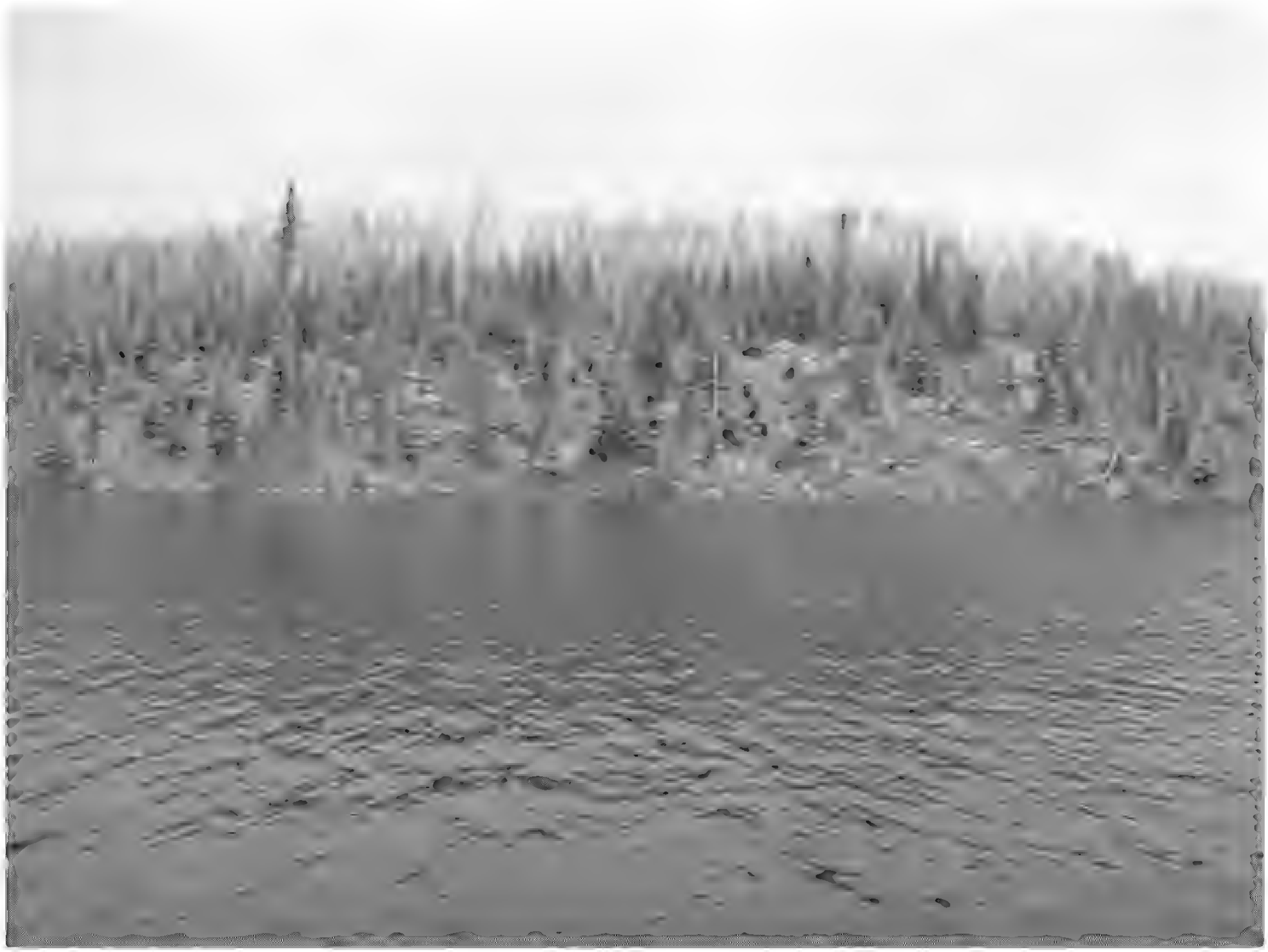


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